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Brown&Sharpe

USER'S MANUAL

MicroVal® 343

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Brown + Sharpe
~~401 886 2000~~
800-283-1883
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Contents

CHAPTER 1 - Introduction 1-1
Foreword 1-3
Warranty 1-4
Software Warranty 1-4
Warranty Service 1-5
General Safety 1-6
Description 1-7
Dimensions - Microval 343 1-12
Dimensions - Microval 454 1-13
Specifications - Microval 343 1-14
Specifications - Microval 454 1-15

CHAPTER 2 - Construction 2-1
Base 2-3
Work Table 2-4
Y-Rails 2-5
Bridge 2-6
ZX Carriage 2-7
Z Rail 2-8
Air Control and Filter 2-9
Air System 2-10
Air Bearings 2-11
Measuring System 2-12
Reference Offsets 2-13
Probes 2-14
TP-ES Probe 2-14
MIP Probe 2-14
Electronic System 2-15
Controllers 2-16
MAN 3 Controller Ports 2-17
Computer with Embedded Board 2-17
MicroVal 343 & 454 - Basic System 2-18
MicroVal 343 & 454 - 2F System 2-19
3B System Package - MINTA Computer 2-20
3B System Package - AST Computer 2-21
MicroVal 343 & 454 - 4M System 2-22

CHAPTER 3 - Operation 3-1
Operator Safety 3-3
Computer Disks 3-6
Use & Care: Computer Disks 3-8
Remote Hand Switch 3-9

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Contents

Using a Mouse 3-10
Starting & Stopping 3-13
Moving the Axes 3-15
Homing the Machine 3-16
The Inspection Process 3-18
Probe Installation 3-19
Measuring With a Ball Probe 3-20
Probe Compensation 3-21
Measuring With an Electronic probe 3-22
Touch Trigger Probe Repeatability 3-23
Useful Probe Dimensions 3-25
Good Measurement Techniques 3-27

CHAPTER 4 - Maintenance 4-1
Machine Maintenance & Safety 4-3
General Safety Practices 4-3
The Machine's Environement 4-3
Electronics 4-4
Covers 4-4
Pneumatics 4-4
Maintenance Intervals 4-5
Daily or Every 8 Hours 4-6
Monthly or 165 Hours 4-6
Every Three Months or 500 Hours 4-6
Maintenance Log 4-7
Machine Troubleshooting 4-8
MicroMeasure Troubleshooting 4-11
UNIX Boot Prompts 4-14
PC Support Tips 4-15
Cleaning Glass Scales 4-17
Changing the Air Filter 4-18
MAN 3 Power Entry Module Assembly 4-19
Voltage Selection 4-19
MAN 3 Power Module Jumper Settings 4-20
MAN 3 Power Entry Module Fuse Changing 4-21

CHAPTER 5 - Glossary 5-1

CHAPTER A - Ram Optical Probe A-1
Installation A-1
Mounting Configuration A-2
Connecting Diagram A-3
Adjustments A-4
Qualification A-6
Measuring A-7

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CHAPTER 1

Introdu

Foreword

The Brown & Sharpe MicroVal® Series Coordinate Measuring Machines represent the accumulated experience of over 160 years in the design and manufacture of dimensional measuring equipment. This experience, combined with many mechanical, pneumatic, and electronic features, has produced a machine which meets the most rigid requirements for the control of dimensional quality.

The MicroVals are designed to meet production needs and to produce speedy, accurate and economical verification of a variety of work pieces.

Imaginative engineering concepts make the MicroVal a practical choice for small shops as well as for large operations. Such innovative design as a completely weight balanced structure and a fully supportive air bearing system allow the attainment and maintenance of high accuracies. Combining these features with the many optional accessories and software packages available, allows the most difficult measurements to be performed on a time-saving production basis.

Since minor changes may be made periodically by Brown & Sharpe to improve machine performance, some components of your particular system may differ from the description in this manual. In such cases, supplementary information will be furnished as needed.

This manual has been prepared to provide the proper procedures to be followed in the installation, operation, and maintenance of the MicroVal. Other manuals and information are also provided where required.

CAUTION

This manual should be read in its entirety by all supervisory and operating personnel prior to installation of the MicroVal. This will help to prevent human injuries as well as damage to the machine components and will assure proper installation, operation and maintenance.

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Warranty

We warrant that within twelve (12) months from the date of shipment, if the product manufactured by us and sold by us under this contract is in the possession of the original buyer (or lessee) from us (or from an authorized distributor), we will replace or repair, at our option, free of charge, any part or parts which upon examination we find defective in workmanship or material, provided that, on our request, the product or parts thereof are returned to our plant, along with satisfactory documentation that the product has been installed, used, and maintained in accordance with instructions in the User's Manual and has not been subjected to abuse.

We warrant that within twelve (12) months from the date of shipment, if the software sold under this contract is in the possession of the original buyer (or lessee), we will replace or correct, at our option, free of charge, any modules or programs which upon examination we find defective in workmanship or function, provided that, on our request, the modules or programs are returned to our plant and, provided further, that there is satisfactory documentation that the software has been installed, maintained and operated in accordance with instructions in the User's Manual, and provided further that there is satisfactory documentation from the customer that a software defect exists.

In addition, there may be specified Occupational Safety & Health Standards Warranties which, if applicable to the product, are set out in the attached schedule and incorporated by reference and subject to the provision hereof.

We shall not be responsible for any expense or liability for repairs due to the making of or which result from any additions or modifications upon the product without our written consent and approval or which expense or liability for repairs results from a failure to follow the Manufacturer's Preventive Maintenance Schedule as set forth in this Manual.

THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESS OR IMPLIED WARRANTIES (INCLUDING WITHOUT LIMITATION ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE). IN NO EVENT SHALL WE BE LIABLE FOR ANY SPECIAL INDIRECT OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, LOST PROFITS OR OTHER DAMAGES FROM LOSS OF PRODUCTION) CAUSED BY DEFECTIVE MATERIAL, OR BY UNSATISFACTORY PERFORMANCE OF THE PRODUCT, OR BY ANY OTHER BREACH OF CONTRACT BY US.

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Warranty Service

During the warranty period, as defined previously, remedial service assistance on the machine and control will be furnished at no charge by Brown & Sharpe when this equipment is in operation in the USA or in Canada.

In the event that you should require information or service assistance for your MicroVal, it is recommended that you call the dealer from whom the machine was purchased or one of the Brown & Sharpe regional offices. Due to the complexity of this machine, we recommend only Brown & Sharpe factory authorized service centers be used.

For information and assistance in the United States contact one of the following:

Brown&Sharpe
World Headquarters
Precision Park, 200 Frenchtown Road ,
North Kingstown, RI 02852-1700
Tel: (800) 766-4673 Fax: (800) 933-2937

DEA spa, Corso Torino, 70,
10024 Moncalieri (TO) Italy
Tel: 011 69351 Fax: 011 6610855

Leitz Meßtechnik GmbH,
Siegmund-Hiepe Straße 2-12,
D-35578 Wetzlar, Germany
Tel: 6441 2070 Fax: 6441207 122

Brown & Sharpe-USA
Sunnyvale, CA
Tel: (408) 733-1200 Fax: (408)733-0198

Brea, CA
Tel: (714) 256-5520 Fax: (714) 256-5522

Elk Grove Village, IL
Tel: (847) 593-5950 Fax: (847) 593-6619

Farmington Hills, MI
Tel: (810) 553-9311 Fax: (810) 553-0267

Fridley, MN
Tel: (612) 571-7277 Fax: (612) 571-7399

Charlotte, NC
Tel: (704) 525-0182 Fax: (704) 525-3154

Cincinnati, OH
Tel: (513) 942-0800 Fax: (513) 942-0804

Middleburg Heights, OH
Tel: (216) 816-0440 Fax: (216) 816-0536

Nashville, TN
Tel: (615) 331-0800 Fax: (615) 331-0875

Kent, WA
Tel: (206) 251-5953 Fax: (206) 251-6172

Brown & Sharpe-E
Ludwigsburg, Germa
Tel: 7141 8747 0 Fax

Telford, United King
Tel: 952 681317 Fax:

Swindon, United Kin
Tel: 793 877633 Fax:

Renens, Switzerland
Tel: 21 6341551 Fax:

Vilnius, Lithuania
Tel: 2 771 848 Fax: 2

Villebon Sur Yvette C
Tel: 1 69318400 Fax:

Barcelona, Spain
Tel: 3 4740071 Fax:

Brown & Sharpe-As
Causeway Bay, Hong
Tel: 2 881 8007 Fax:

Kanagawa Pref., Japa
Tel: 462 346195 Fax:

Beijing, China
Tel: (10) 3186561 Fa

Singapore
Tel: 65 4635830 Fax:

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General Safety

This manual should be read in its entirety by all supervisory and operating personnel before installation, operation and maintenance. The MicroVal has been designed to minimize possible hazards to the operator and sources of damage to the machine. While it is impossible to anticipate every situation, strict adherence to the safety rules in this manual will reduce the possibility of injury to personnel and damage to the machine.

Set up personnel and operators should be completely familiar with the controls, safety devices and operation of this machine. Safe operating procedures should be defined and applied at all times during setup, operation and maintenance.

The procedures outlined in the following pages can be used as a guide to establish safe operating and maintenance procedures. Additional information on the safe operation and guarding of machines is available from the United States Department of Labor.

Every effort should be made to keep your machine safe. A daily safety inspection should be made in addition to the normal maintenance inspection. Machine operators should be aware of safe operating procedures and apply these procedures at all times during operation. Particular emphasis should be placed on ensuring that all guards are on the machine, in good condition and fastened securely. **Never operate the machine when its guards are removed.**

Icons indicate the following:

Note
This symbol informs you of special circumstances.

The following symbols denote that extra caution should be exercised.

Caution
This symbol refers to safety information

Caution: High Voltage
This symbol is associated with voltages that are dangerous to life. Use extreme caution in areas where it is posted.

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Description

The MicroVal Machine
The MicroVal Coordinate Measuring Machine features a lightweight, table top, bridge type design with a removable granite support.

This machine is designed to accommodate moderate sized work pieces with an economical table mounted unit.

This series of machines incorporates the following features:

- A granite worktable that provides a stable, precision measuring surface that is practically maintenance free.
- M10 threaded, stainless steel inserts imbedded into the granite table for securing the workpiece.
- Air bearings for frictionless movement of all axes.
- A fully pneumatic, counterbalanced column, infinitely adjustable for varying probe weights, with a built-in braking device.
- A Z-Rail Probe Holder that accommodates a wide variety of probes and accessories.
- A machine construction that allows accurate measurement of steel parts over a wide temperature range.
- A video monitor or optional personal computer.
- An optional selection of different levels of menu driven 2D/3D interactive software.

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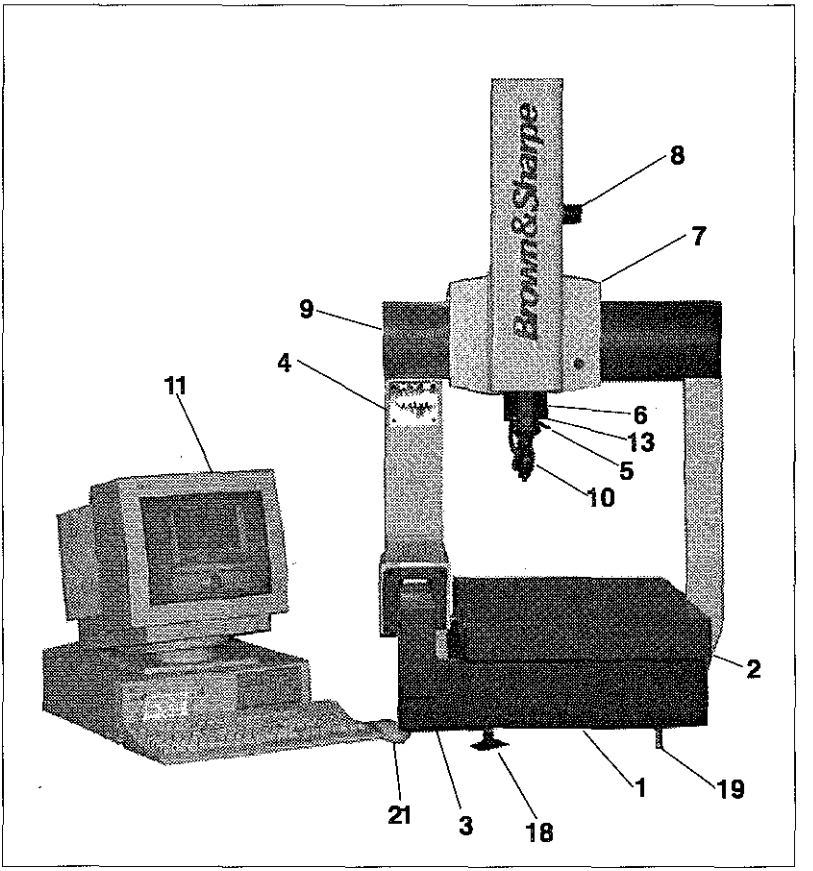
Description



The MicroVal 343 System consists of the following main components:

1. Base
2. Granite Table
3. Y-Axis Rails
4. Bridge
5. Probe Locking Lever
6. Z-Rail
7. X-Z Carriage
8. Counterbalance Adjust Knob
9. Axis Lock Switches
10. Probe
11. Video Monitor or PC System
12. Bench (Optional)
13. ZMouse
14. Electronic Cabinet (Rear) (Optional for 1T)
15. Air Supply (Rear)
16. Air Bearings (Not visible)
17. Measuring System (Not visible)
18. Machine Leveling Feet
19. Anti-tip Bolts
20. Granite Leveling Feet (Not visible)
21. Hand Control (Optional)
22. Light Pen (Optional on some systems)

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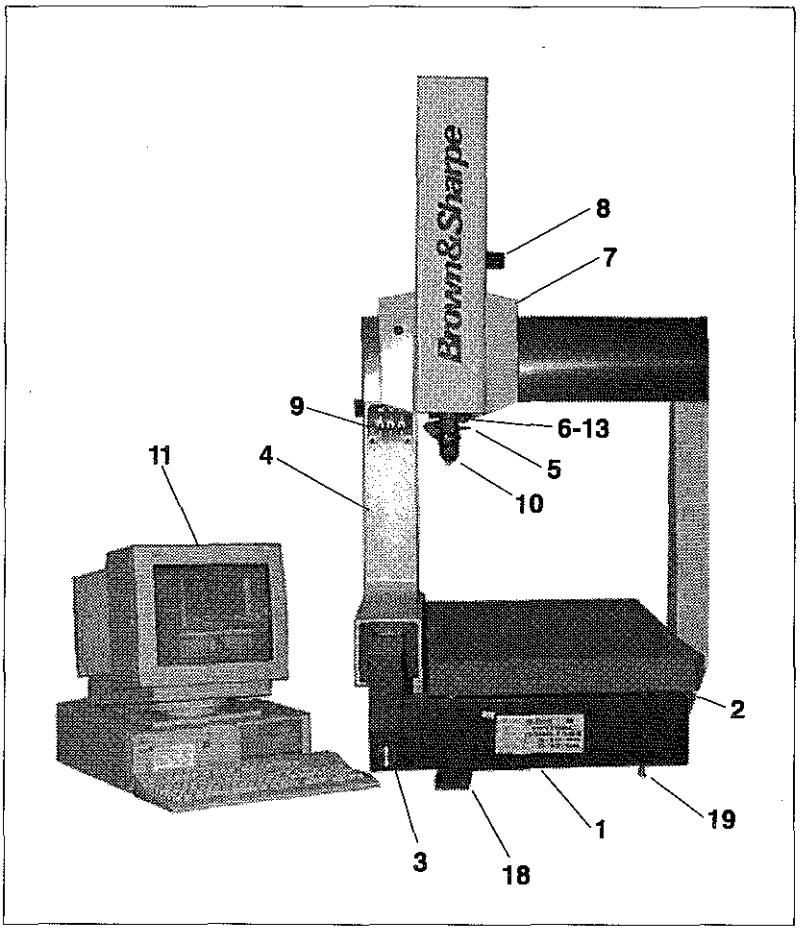
Description



The MicroVal 454 System consists of the following main components:

1. Base
2. Granite Table
3. Y-Axis Rails
4. Bridge
5. Probe Locking Lever
6. Z-Rail
7. X-Z Carriage
8. Counterbalance Adjust Knob
9. Axis Lock Switches/Fine Adjust Engagement
10. Probe
11. Video Monitor or PC System
12. Bench (optional)
13. ZMouse
14. Electronic Cabinet (rear) (Optional for 1T)
15. Air Supply (rear)
16. Air Bearings (not visible)
17. Measuring System (not visible)
18. Machine Leveling Feet
19. Anti-tip Bolts
20. Granite Leveling Feet (not visible)
21. Hand Control (Optional)
22. Fine Adjustment Knob

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Description

1. BASE - Aluminum casting of open web design with three isolation-type leveling pads. Its construction supports the granite table and provides rigidity and stability for accurate machine operation and measurement.

2. GRANITE TABLE - Mounted on ball and "V" supports, the table provides a means for locating and clamping parts to be inspected.

3. Y-AXIS RAILS - Mounted to the base, they provide the means of guiding the bridge in an accurate and straight line along the Y axis.

4. BRIDGE - A movable structure that consists of the left and right legs along with the X axis rail. This structure is movable on the rails for Y axis measurements. The X axis rail forms the top portion of the unit and provides the means for guiding the carriage in an accurate and straight line along the X axis.

5. PROBE LOCKING LEVER - A lever that is used to clamp and release the probe in the Z-rail probe holder.

6. Z-RAIL - An adjustable, counterbalanced rail that is movable vertically in the carriage for making Z axis measurements. The rail houses a pneumatic counterbalance that is infinitely adjustable for varying probe weights. It is also provided with the means for attaching various types of probes and accessories.

7. X-Z CARRIAGE - A structure movable on the rail for X axis measurements. The carriage contains the air bearings for the X rail as well as the air bearings for the Z rail.

8. COUNTERBALANCE ADJUST KNOB -This knob is used to adjust the counterbalance cylinder for the varying probe weights.

9. AXIS LOCK SWITCHES - On the MicroVal 343 these switches are used to lock or release the machine axes. On the MicroVal 454 the switches are used to engage or release the fine adjust mechanism.

10. PROBE - Probes are either hard or touch trigger types and are used to take measurements on the piece being measured.

11. VIDEO MONITOR - A video monitor with large, easy to read characters and a choice of languages. The display provides XYZ readouts, software menu selections and data input capabilities.

12. BENCH (OPTIONAL) - A support for the machine, the monitor, the electronic cabinet and air supply. It supports the machine at the proper height for operator movements.

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Description

13. Z MOUSE - Used with the monitor for menu selection, measurement point taking (1T machines), and for data input.

14. ELECTRONIC CABINET - Mounted on the floor, the cabinet houses the microprocessor control board, multiplier board and power supply.

15. AIR SUPPLY - Provides and distributes air to the air bearings for smooth, frictionless travel of the bridge, carriage and Z rail. The air supply is also used for the adjustable Z rail counterbalance.

16. AIR BEARINGS - The air bearings provide noncontact, frictionless movement of the bridge, carriage, and Z rail along their respective ways.

17. MEASURING SYSTEM - A highly accurate, opto-electric system, consisting of a scale and an encoder head, which sends electronic signals to the readout as it moves along the scale.

18. MACHINE LEVELING FEET - Three screws and pads used to isolate the machine from vibrations and to level the machine.

19. ANTI-TIP BOLTS - Two bolts in the machine base that prevent the machine from tipping if it is bumped or has an unbalanced load.

20. GRANITE LEVELING FEET - Three ball-end screws in the top of the base that provide a three point support for the table. They are also used to level the granite to the X and Y axes.

21. HAND CONTROL (Optional) - Used to take hits with a hard probe it also contains a hit inhibit switch for use when a touch trigger probe and a beeper is used to signify a touch probe hit. The handswitch has a button that functions as either a "Done" key or a "More" key.

22. FINE ADJUSTMENT - Allows precise adjustment of all three axes by means of knurled knobs (MicroVal 454 only).

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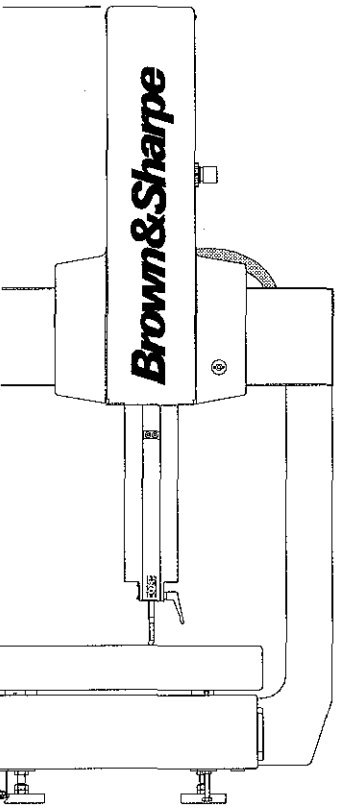
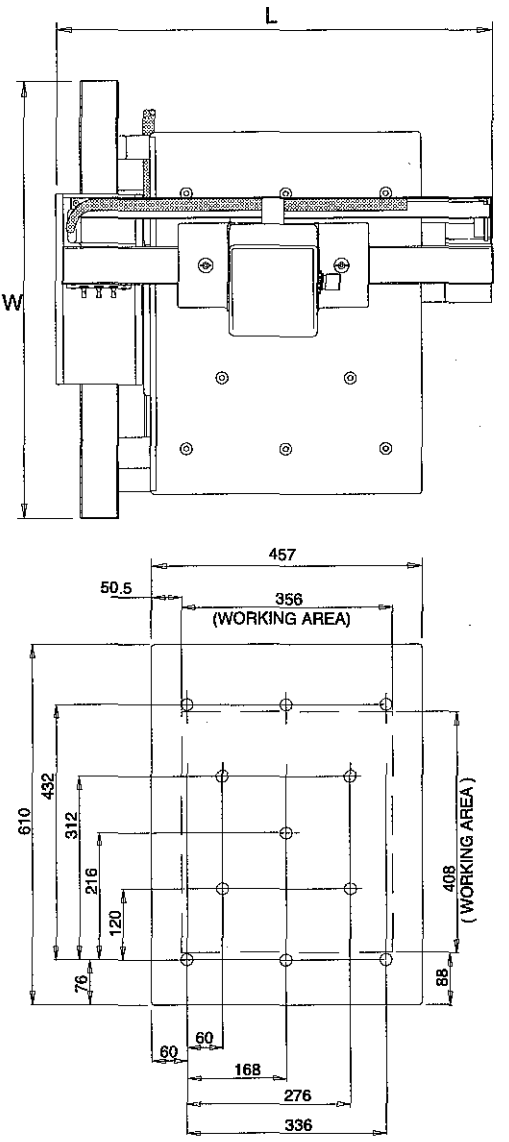
Dimensions - MicroVal 343





MICROVAL 343 MEASUREMENTS ARE LISTED ON THE SPECIFICATIONS SHEETS

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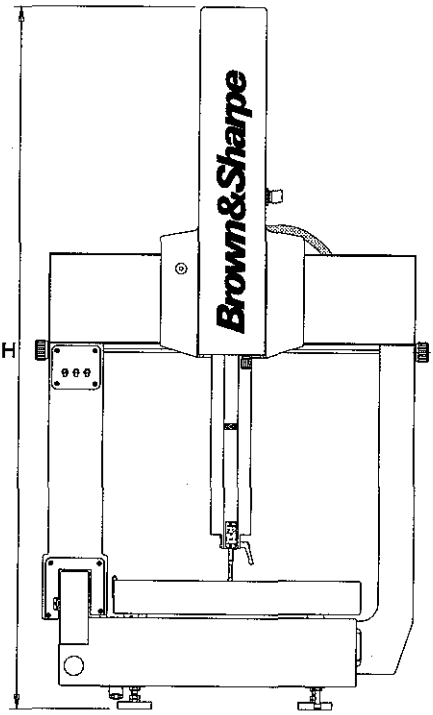
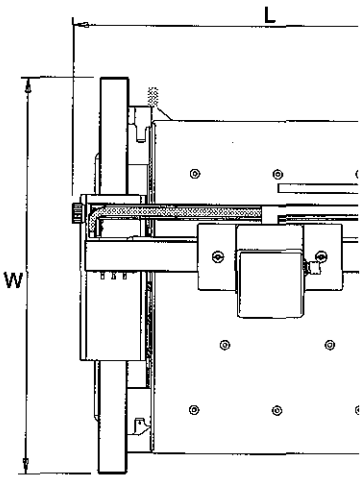
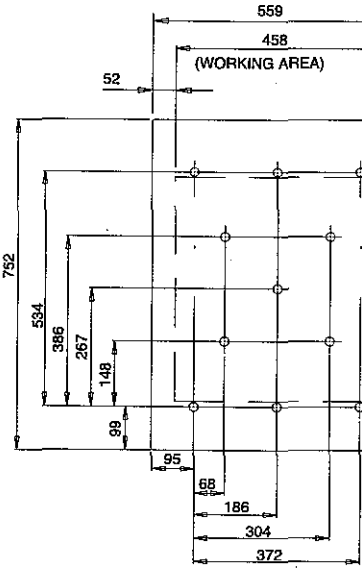
Dimensions - MicroVal 454







MICROVAL 454 MEASUREMENTS ARE LISTED ON THE SPECIFICATIONS SHEETS

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Specifications - MicroVal 343

PERFORMANCE	METRIC	ENGLISH
Repeatability B89	0.004 mm	0.00016 in.
Volumetric Accuracy B89	0.010 mm	0.0004 in.
Linear Accuracy B89	0.005 mm	0.0002 in.
Resolution	0.0005 mm	0.00002 in.
Display Range	+/-9999.999 mm	+/-999.99999 in.
Measuring Speed (Min.)	760 mm/sec	30 in/sec
DIMENSIONS		
Measuring Range *	356 x 406 x 305 mm	14 x 16 x 12 in.
Length	743 mm	29.25 in.
Width	730 mm	28.75 in.
Height	1340 mm	52.75 in.
Weight (Machine/granite)	150 kg	330 lbs
Weight (Complete system)	168 kg	370 lbs
Shipping Weight	234 kg	515 lbs
Maximum Part Weight	227 kg	500 lbs
Part Size Capability (X,Y,Z)	457 x 610 x 381mm	18 x 24 x 15 in.
OPERATIONAL REQUIREMENTS		
Calibration Temperature	20°C±1.1°C	68°F±2°F
Operating Temp. Range	10° to 40°C	50° to 104°F
Storage Temperature	-30° to 60°C	-22° to 140°F
Minimum Air Input	4.8 BAR	70 psi
Air Consumption	100 NL @ 3.75 BAR	3.5 SCFM @ 55 psi
Power Requirements	100 to 240 VAC 50/60 HZ	100 to 240 VAC 50/60 HZ
Power Consumption-Elec.	200 Watts Max.	200 Watts Max.
Power Consumption-CRT	50 Watts Max.	50 Watts Max.

* Machine range when using 3.0" (75 mm) long probe.
B89 Repeatability is measured with a trihedral probe in the center of the granite.
B89 Volumetric Accuracy is measured with a 10" (250mm) Ball Bar and Electronic Probe.
B89 Linear Accuracy is measured with a laser in the center of machine travel.

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Specifications - MicroVal 454

PERFORMANCE	METRIC	ENGLISH
Repeatability B89	0.004 mm	0.00016 in.
Volumetric Accuracy B89	0.010 mm	0.0004 in.
Linear Accuracy B89	0.005 mm	0.0002 in.
Resolution	0.0005 mm	0.00002 in.
Display Range	+/-9999.999 mm	+/-999.99999 in.
Measuring Speed (Min.)	760 mm/sec	30 in/sec
DIMENSIONS		
Measuring Range *	457 x 508 x 406 mm	18 x 20 x 16 in.
Length	895 mm	35.25 in.
Width	885 mm	34.8 in.
Height	1575 mm	62 in.
Weight (Machine/granite)	180 kg	395 lbs
Weight (Complete system)	218 kg	480 lbs
Shipping Weight	300 kg	660 lbs
Maximum Part Weight	227 kg	500 lbs
Part Size Capability (X,Y,Z)	559 x 750 x 483mm	22 x 29.5 x 19 in.
OPERATIONAL REQUIREMENTS		
Calibration Temperature	20°C±1.1°C	68°F±2°F
Operating Temp. Range	10° to 40°C	50° to 104°F
Storage Temperature	-30° to 60°C	-22° to 140°F
Minimum Air Input	4.8 BAR	70 psi
Air Consumption	100 NL @ 3.75 BAR	3.5 SCFM @ 55 psi
Power Requirements	100 to 240 VAC 50/60 HZ	100 to 240 VAC 50/60 HZ
Power Consumption-Elec.	200 Watts Max.	200 Watts Max.
Power Consumption-CRT	50 Watts Max.	50 Watts Max.

* Machine range when using 3.0" (75 mm) long probe.
B89 Repeatability is measured with a trihedral probe in the center of the granite.
B89 Volumetric Accuracy is measured with a 12.8" (325mm) Ball Bar and Electronic Probe.
B89 Linear Accuracy is measured with a laser in the center of machine travel.

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MicroVal Notes

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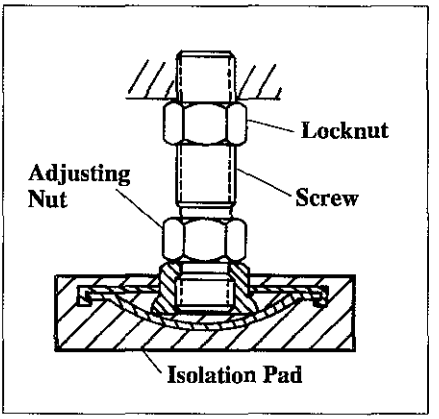
CHAPTER 2

Constru

Base

The MicroVal is supported by a base that is an aluminum casting of open web design. This construction provides a structure that is both light and stiff.

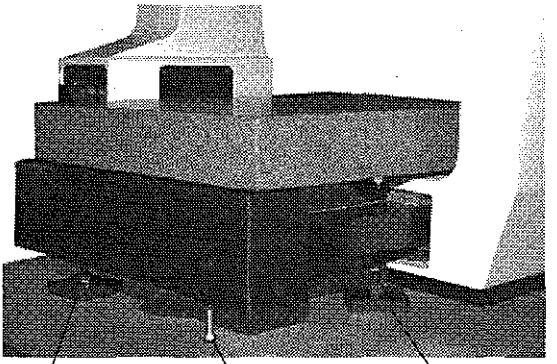


Three isolation pads with adjustable screws and nuts are fastened to the bottom of the base and are used for leveling the machine. The pads also prevent vibrations from being transmitted to the machine and the workpiece.

Two adjustable bolts are fastened to the bottom of the base and are set with .040"-.060" (1mm-1.5mm) clearance above the top of the bench. These bolts prevent the MicroVal from tipping, if it should be bumped or loaded in an unbalanced condition.

Note: These anti-tip bolts **Must Not** touch the bench under normal conditions. Three ball-end screws, fastened in the top of the base, provide a three point support for the work table. These screws are leveled at the factory and do not normally require adjustment. These screws should only be adjusted if the work table is not level with the X and Y axes.

The cable track is mounted to the base and houses the encoder cable and air hoses. The Y axis cable is in a loop between the rail and the base which reduces hysteresis.



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Work Table

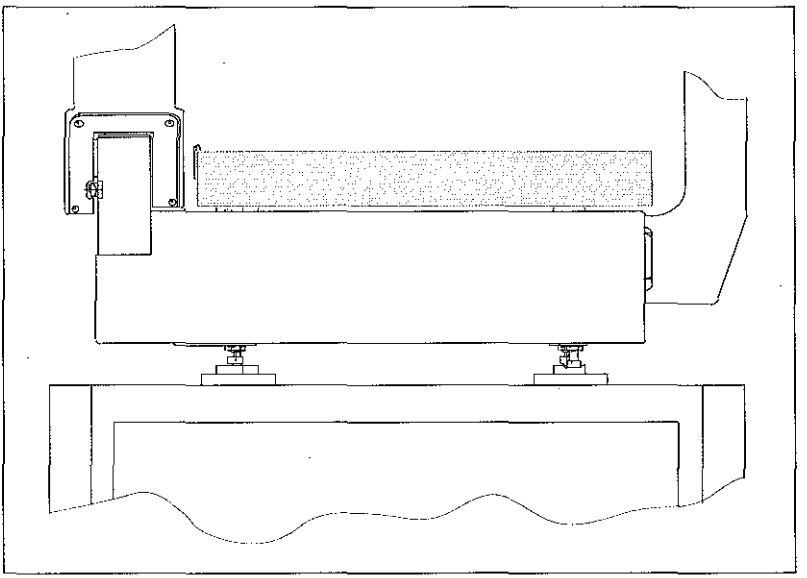
The work table is granite with a flat lapped surface that serves as the support for the parts to be measured. Three V-grooved blocks, mounted to the bottom of the work table, rest on ball-end screws in the top of the base. The V-grooves are oriented to allow the table to expand and contract with the machine.

The dark and light areas that appear in the granite are not defects but rather natural concentrations or absences of black magnetite mineral. These color variations do not affect the hardness, durability or accuracy of the granite surface.

A number of stainless steel M10 threaded inserts are uniformly spaced throughout the measuring area for clamping work pieces to the table. **Note: Bolts used for clamping the work pieces must not be overtightened, or the inserts may pull loose from the granite. Maximum torque is 15 ft-lbs.**

The top of the granite table is flat to within 1" (25.4mm) of the table's edges.

The work table should be kept clean by wiping with alcohol, particularly when this surface is being used as a datum.



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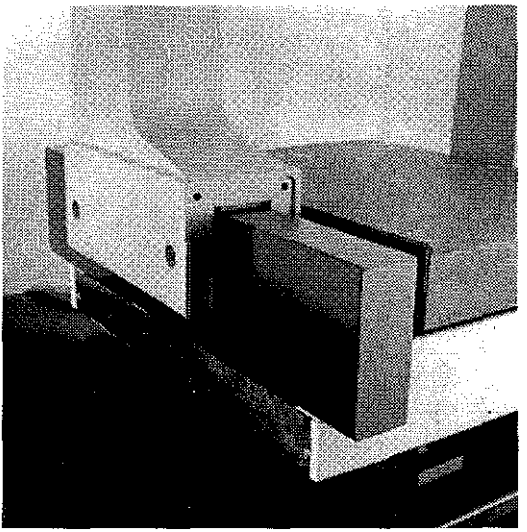
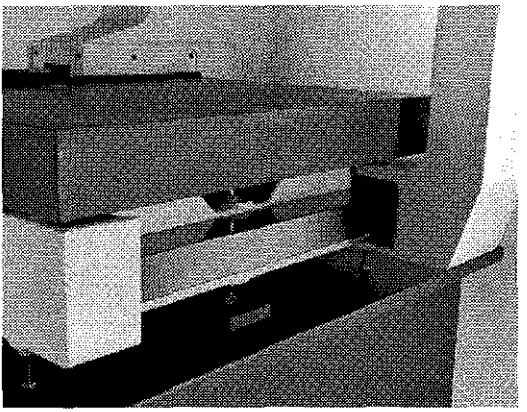
Y-Rails

The Y-Rail is a light-weight, hard-coated anodized, aluminum rail that is both bolted and epoxied to the left side of the base. The top and outside of the rail are the positive sides. The Y-Rail controls five (5) degrees of freedom. It also serves as a support and guide for the left outboard leg of the bridge. The Y-axis measuring scale is recessed into the Y-Rail. Note: The scale is protected by a cover on the MicroVal 454 machine.



The Y-Roll Rail is also a lightweight, hardcoated, aluminum rail that is both bolted and epoxied to the right side of the base. This Roll Rail supports the right inboard leg of the bridge with air bearings on top and underneath the rail.

It is very important that the rails be kept clean and not be bumped when parts are loaded and unloaded. **Never lift the MicroVals by the Y-Rails.**



Note: Although the guide rails are hardcoated and anodized, they can be damaged by a bang or bump from a hard object. Never place objects against the rails and avoid lifting over the rails when loading or unloading parts.

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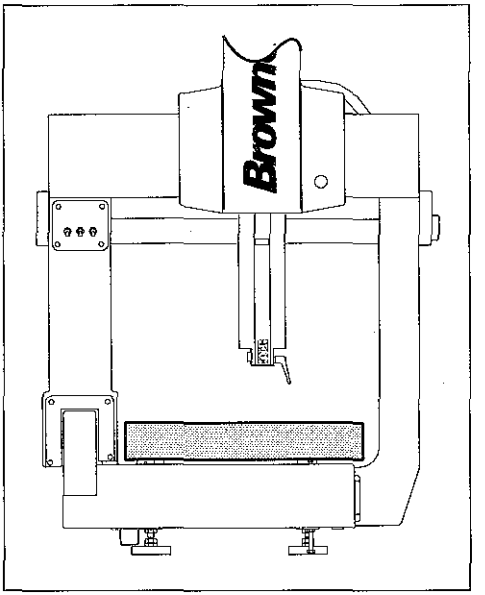
Bridge

The MicroVal is a vertical, moving bridge type of CMM. The Bridge travels along the Y-rail at a right angle to the front of the machine. It is of modular construction and consists of a left outboard leg, a right inboard leg and an X-Rail which spans the two legs.



The left leg is an aluminum casting that results in a member that is both structurally light and stiff. The leg contains seven (7) air bearings which provide virtually frictionless movement and support in the Y direction. An air harness contains the lines for the air bearings as well as for the axes air switches located at the front of the left leg.

The air switches control the lines from the manifold to the preload bearings for each axis. On the MicroVal an axis can be locked by toggling the air switch off (down) and deflating the preload bearings for that axis. On the MicroVal 454 the air switches are additionally used to engage or release the fine adjust mechanisms. These mechanisms, mounted on the X, Y and Z axes, are used for precise adjustment of the individual axes.

The Y-axis encoder is mounted in the lower part of the leg, beneath an access plate. Elastomeric bumpers on the leg act as stops when contacting the base at the end of travel.

The right leg is also an aluminum casting and contains two (2) air bearings for virtually frictionless movement. The bearings are preloaded for improved accuracy of the MicroVal.

The X-rail is a lightweight, hardcoated, aluminum that spans the two legs and serves as both support and guide for the X-Z carriage. The X-rail is both bolted and epoxied to the left leg and bolted to the right leg. A cable track is provided for the X-axis loop to reduce hysterisis and improve accuracy.

The X-axis measuring scale is recessed into the back side of the X-rail. The scale is protected by a cover on the MicroVal 454 machine. The top and front sides of the rail are the positive sides.

Note: Although the guide rails are hardcoated and anodized, they can be damaged by a bang or bump from a hard object. Never place objects against the rails and avoid lifting over the rails when loading or unloading parts.

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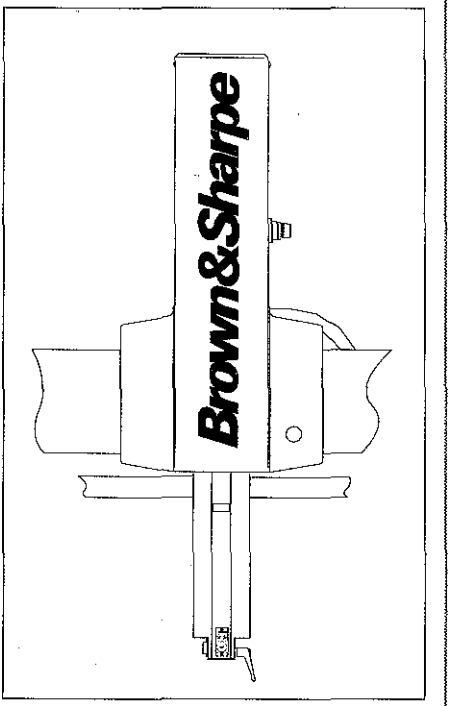
ZX Carriage

The ZX Carriage travels along the X-rail parallel to the front of the machine. The carriage is an aluminum casting that is both structurally light and stiff. The carriage houses nine (9) air bearings which provide virtually frictionless movement and support in the X direction.

The ZX Carriage also contains eight (8) air bearings that support the Z-rail. The X-axis encoder and the Z-axis encoder are located under removable covers at the back of the machine. Removing these covers provides access to the Z-axis scale.

Cable mounts are located at the rear of the carriage and elastomeric bumpers on each end act as stops against the legs in the X direction.

A large knurled knob at the bottom of the carriage is used for the precise adjustment of the Z-rail on MicroVal 454 machines.



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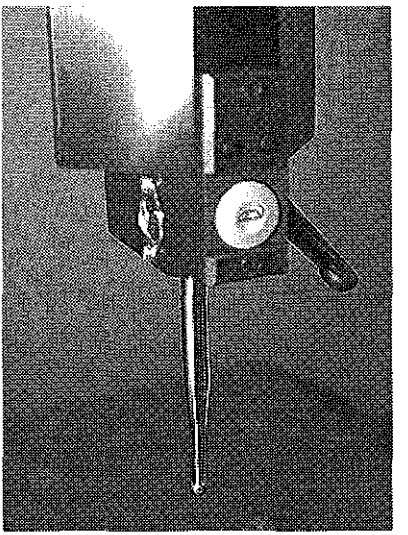
Z Rail

The Z-rail travels vertically at right angles to both the X and Y axes. The rail has an octagonal cross section and moves virtually without friction. The rail is made from a lightweight, hardcoated aluminum and is supported by eight (8) air bearings in the ZX carriage.

A pneumatic counterbalance, adjustable for varying probe weights, is mounted in the Z-rail. The counterbalance consists of a cable suspended piston in a cylinder.

The Z-axis measuring scale is recessed in the back of the rail. The scale is partially exposed when the Z-rail is in its lowermost position. Two mechanical stops with elastomeric bumpers control the travel of the Z-rail. **Note: These stops must not be removed or the rail will drop on the table.**

The Z-rail has a built-in failsafe brake that operates off the pneumatic system. If air pressure is lost in the counterbalance, the Z-axis air bearings will lock, preventing the rail from dropping on the work table.



A probe holder built into the bottom of the Z-rail has a locking lever and spring plunger detent to hold the probe in place while clamping. The orientation of the locking lever can be changed by pulling the lever out to disengage it from its spline and reengaging the lever in a new location. When engaged, the lever can be turned to clamp or release the probe. The Z rail has a mouse with a button for moving the cursor on the monitor screen, a button for selecting menu items amd a button to record measurement points.

The machine is prewired to accept the optional Touch Trigger Probe. A cable is assembled thru the center of the Z-rail with a socket at the lower end of the rail for electronically connecting the Touch Trigger Probe.

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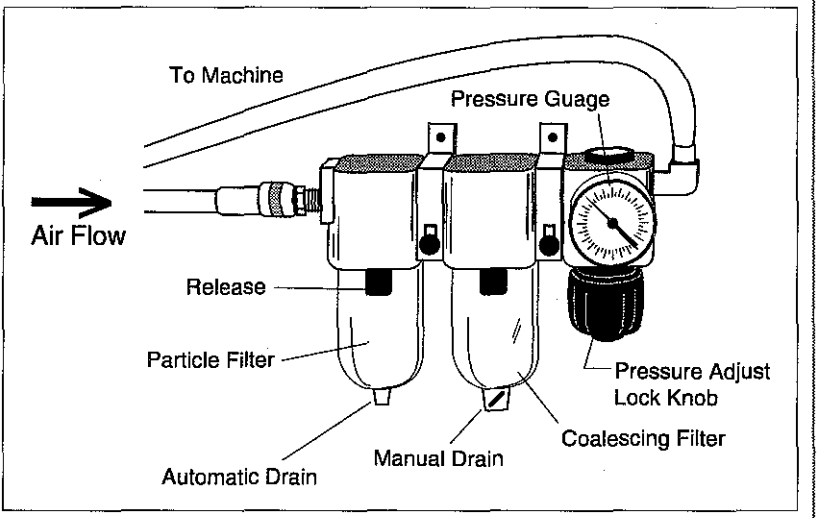
Air Control and Filter

Air is used on the MicroVal for air bearing operation and for the Z-rail counterbalance. The system is designed to operate at 55+0/-1 PSI (3.75 BAR). The inlet air supply should be a minimum of 70 PSI (4,8 BAR) and should provide for a minimum consumption of 3.5 SCFM (100 NL).

The supply line is connected to the input port. The air passes through a primary filter and a secondary filter. A regulator connected after the filters is used to set system pressure. When the pressure is set, the pressure adjusting knob should be locked with the friction lock knob located at the bottom of the regulator.



The filter-regulator unit is normally mounted at the side of the support bench. A bracket is supplied for mounting and can be attached to a customer supplied bench. **The filter-regulator must be mounted vertically as shown. Failure to do this will cause the unit to malfunction and void the machine warranty.**

A second regulator controls the air pressure in the counterbalance cylinder. This regulator is mounted on the right side of the rear cover of the ZX cariage and is adjusted to compensate for varying probe weights.

Always hold the Z-rail firmly when unlocking the Z-axis and adjusting the counter- balance. The knob must be rotated clockwise to increase the lift for heavier probes and counterclockwise to decrease the lift.

If the counterbalance is adjusted with the axis lock 'on', the safety brake may be triggered because the air pressure is set too low. If this occurs, unlock the axis and turn the pressure up until the counterbalance unlocks. Hold the Z-rail firmly as it may move suddenly when the brake unlocks.

On the MicroVal 454 machine the air switches are used both as axis locks and also to engage and release the fine adjust mechanism. The fine adjust mechanisms are used for precisely adjusting the machine's three axes.

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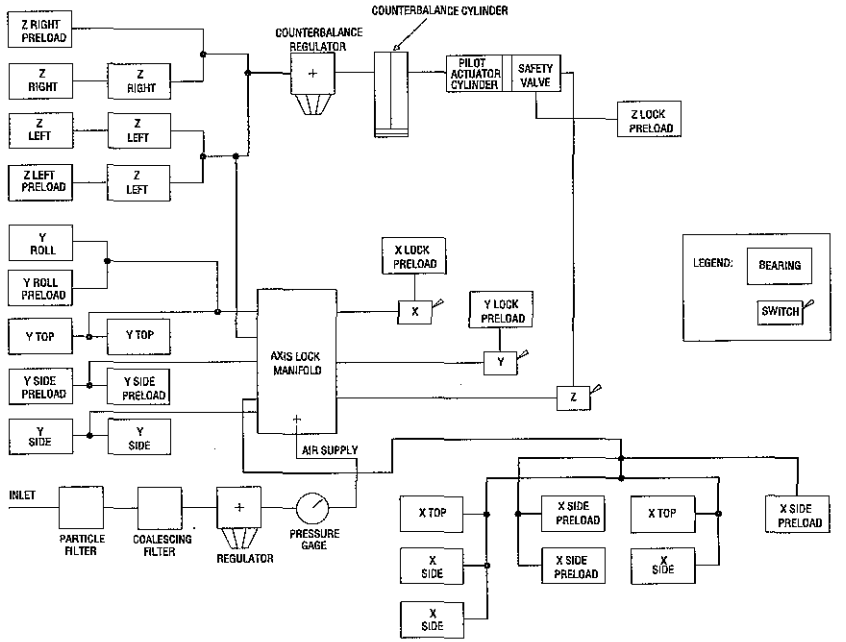
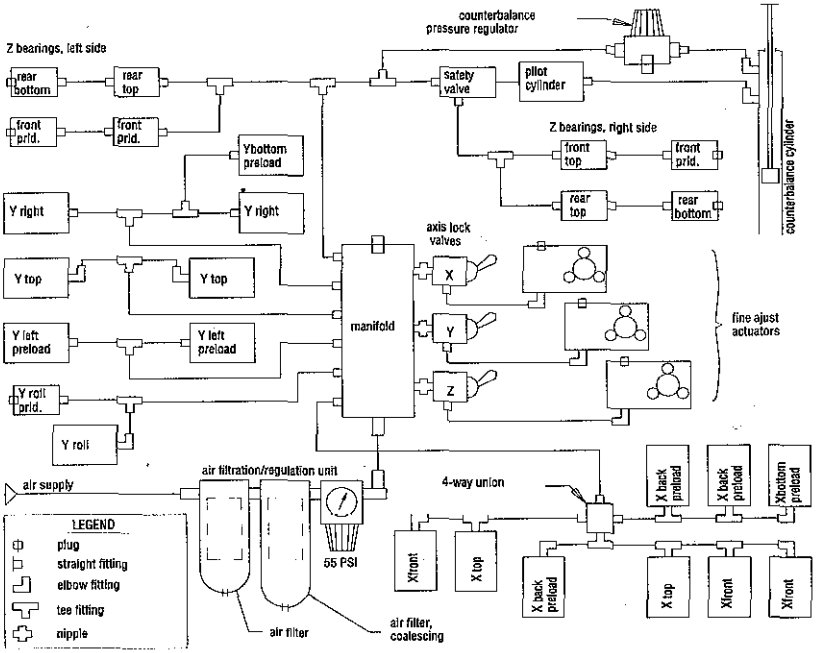
Air System





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Air Bearings

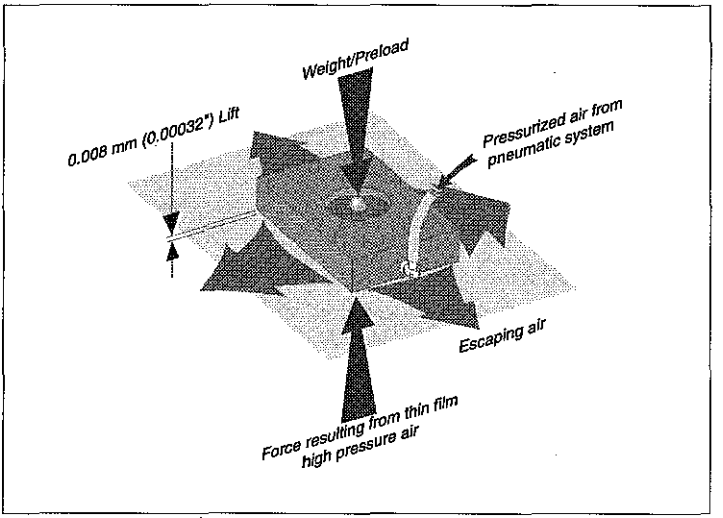
Twenty-six (26) air bearings are used on the MicroVal to provide virtually frictionless, noncontact travel along the respective axes. Air supplied to the bearings is forced through an orifice in the active surface and is uniformly distributed throughout the surface by a system of grooves. Air pressure between the bearing and the rail causes the bearing to float, allowing air to escape. The bearing retracts until the pressure is equalized by the preload or weight on the bearing.

The X axis has nine (9) bearings. There are three (3) at the front of the X rail, three (3) at the rear, one (1) at the bottom, and two (2) on the top. Five of the bearings are positive and four are preloaded.

The Y axis has nine (9) bearings. There are seven (7) on the Y rail and two (2) on the Y roll rail. The Y rail has two (2) on the top, two (2) on each side, and one (1) on the bottom. The Y roll rail has one (1) on the top and one (1) on the bottom. Five bearings are positive and four are preloaded.

The Z axis has eight (8) bearings, four (4) at the front and four (4) at the rear. Five of the bearings are positive and three are preloaded.

The air bearings are adjustable, however, since the MicroVal is calibrated with the air bearings at a given setting, any adjustments will require recalibration and thus should be changed only by Brown & Sharpe service engineers.


Weight/Preload
0.008 mm (0.00032") Lift
Pressurized air from pneumatic system
Escaping air
Force resulting from thin film high pressure air

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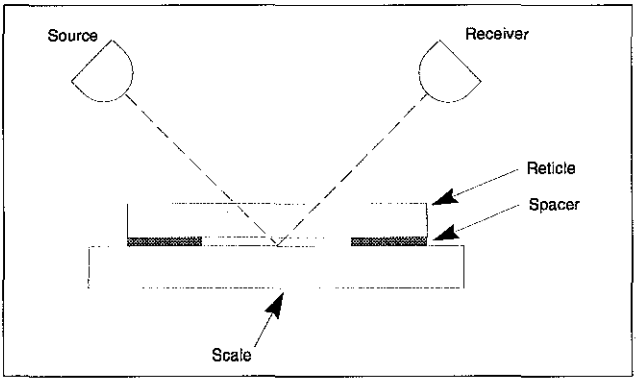
Measuring System

The measuring system on the MicroVal features glass scales which are etched alternately of lines and spaces of equal width. The glass scales are firmly mounted to each of the axes rails. These mountings allow the scale to expand and contract along with the machine.

This system is represented schematically and consists of the following:

1. A light source
2. A reticle
3. A spacer
4. A line scale
5. A receiver



An opto-electrical procedure is used to read the incremental scale divisions. According to the principle of reflected light, the scale division at the scanning point is lit at an angle by a light source. The reflected light strikes a receiver which converts the light energy to electrical energy.

The lines on the scale consist of a highly reflective material while the gaps are non-reflective. A reticle, with divisions at the same intervals as the scale, is moved directly over the scale.

The reticle, like the scale, is made of optical glass with opaque lines and transparent divisions. As the reticle is moved over the scale, the reflective lines of the scale are alternately covered and uncovered. As the reticle lies between the scale and the light source, the intensity of the light reaching the receiver varies as the reticle or scale moves.

The light reaching the receiver generates periodic signals depending upon the variations in light intensity. These signals are converted into digital measurement signals which are used to measure the distance traveled along the scale.

The reticle has additional grating or sets of lines which is physically offset 1/4 of a division (90 degrees) from the first grating. This grating has its own light source and receiver. Its output signal is offset 90 degrees from the signal on the first grating so one signal either precedes or follows the other signal depending on the direction of travel. These signals are electronically evaluated to track the direction of movement.

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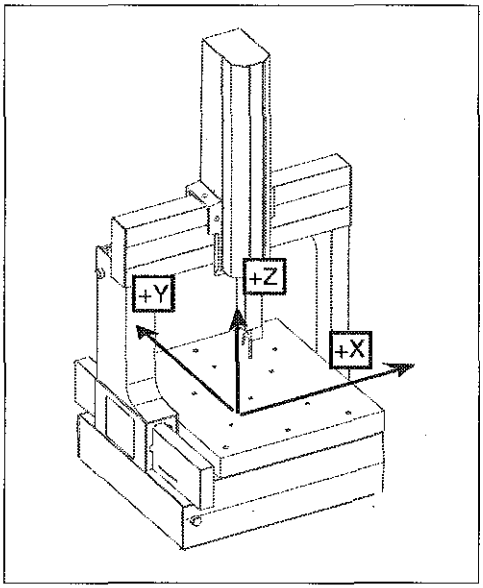
Reference Offsets

- All measurements are in millimeters.
- Values for the TP-ES and MIP are for the probe pointing straight down. (A = 0°, B = 0°)
- Values were measured from the center of the hole in the bottom of the probe holder in the MicroVal. Values are in terms of machine coordinates.
- All values were measured with the probe detent engaged in the probe holder.
- All values should be verified by the machine operator.

Ball Probe:
X Axis: 0
Y Axis: 0
Z Axis: -70

Renishaw TP-ES
X Axis: -10
Y Axis: 0
Z Axis: -95

Renishaw MIP
X Axis: 0
Y Axis: -5.7
Z Axis: -76



The origin of the coordinate system shown represents the machine origin. The arrows represent the positive direction of the machine's axes (in terms of machine coordinates).

To verify the offsets, move the machine to the home position (upper, front, left position) and read the machine position. This position (X,Y,Z) is the current probe offsets.

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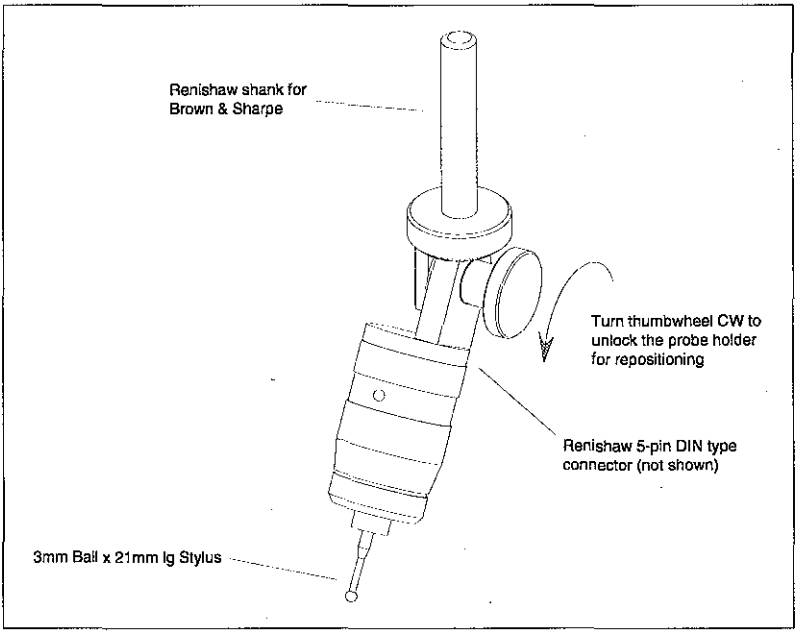
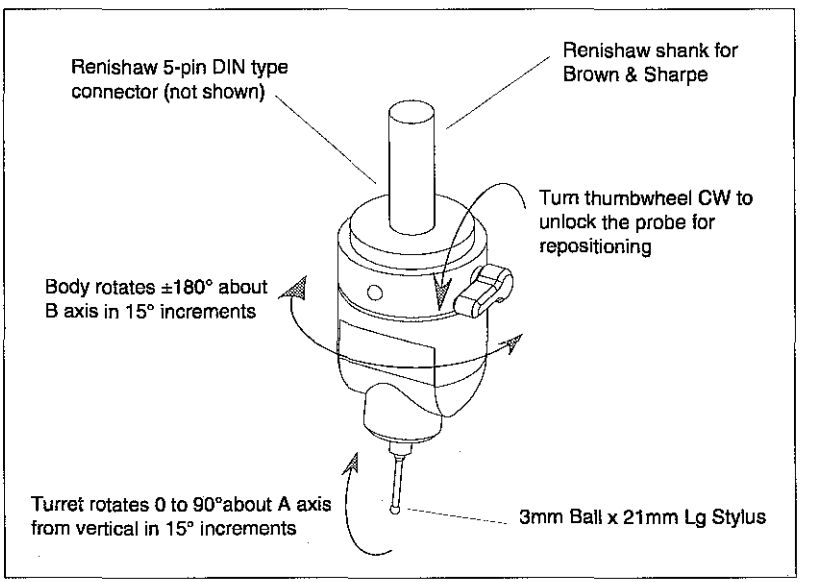
Probes

TP-ES Probe



MIP Probe


Renishaw 5-pin DIN type
connector (not shown)
Renishaw shank for
Brown & Sharpe
Turn thumbwheel CW to
unlock the probe for
repositioning
Body rotates ±180° about
B axis in 15° increments
Turret rotates 0 to 90°about A axis
from vertical in 15° increments
3mm Ball x 21mm Lg Stylus

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Electronic System

The display screen is a video monitor with large easy to read characters and a choice of languages. The display will provide XYZ readout when operating with optional computer assist.

A port is provided for connection of a printer

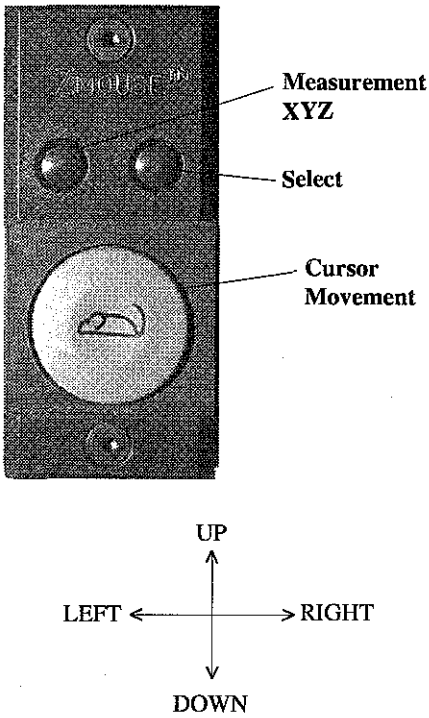
A remote handswitch is furnished and is used to record measurements with a hard probe. This switch also contains a button to turn a touch trigger probe either on or off and a button that functions as either a "Done" key or a "More" key. This switch is not supplied with the MAN4 Control

Z-Rail Mouse

The entry of menu selections and the recording of measurements are done by means of the ZMouse™ with its cursor movement, measurement and select buttons.

To select a menu item or a softkey, move the cursor using the Cursor Movement Button (Mouse) to highlight the item. Press the "Select" button on the mouse to activate the item.

Measurement points are taken by pressing the "Measurement (XYZ)" button on the mouse after positioning the hard probe on the desired surface of the part. Measurement points can also be taken by deflecting an electronic probe (TTP) on the part surface.



Cursor Movement

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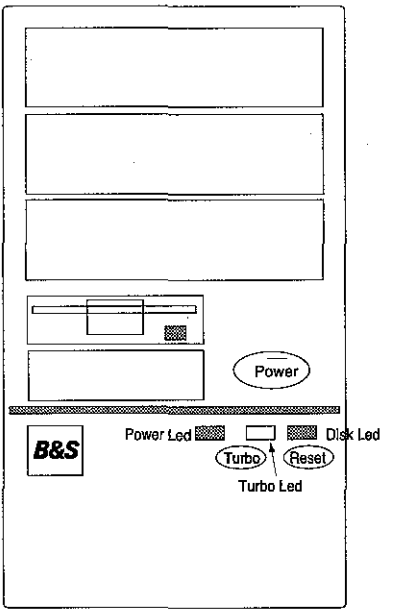
Controllers

There are two types of electronic controllers for MicroVal machines. The controller that is used by your system depends primarily on the measuring software that was ordered with your MicroVal.

The MAN4 controller is a metal cabinet that encloses an encoder multiplier board, the power supply and a power entry module. The MAN4 controller is used for machines running MicroMeasure II++.

The embedded board controller is a card that reads the 3 axis scale encoders and monitors the electronic probe and the handswitch. It fits inside a computer. The compensation data is stored on the hard disk of the computer. At the time of printing, the embedded board is used with MicroVals shipped with MicroMeasure III.



CAUTION

Do not attempt to connect or disconnect any cables when the power is "on". Personal injury and/or electrical damage may occur.

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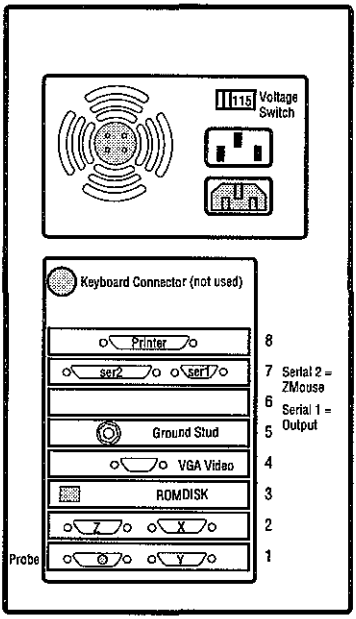
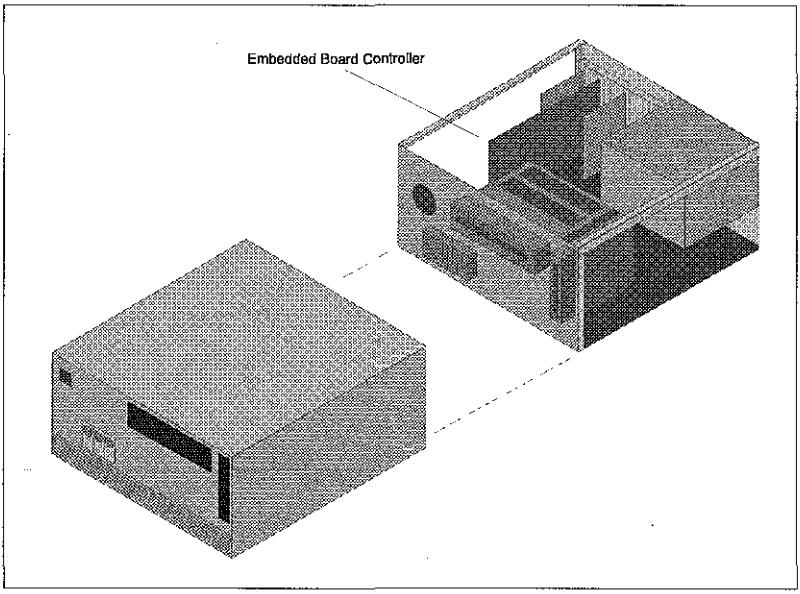
Controllers

MAN4 Controller Ports



Brown & Sharpe Computer with Embedded Board



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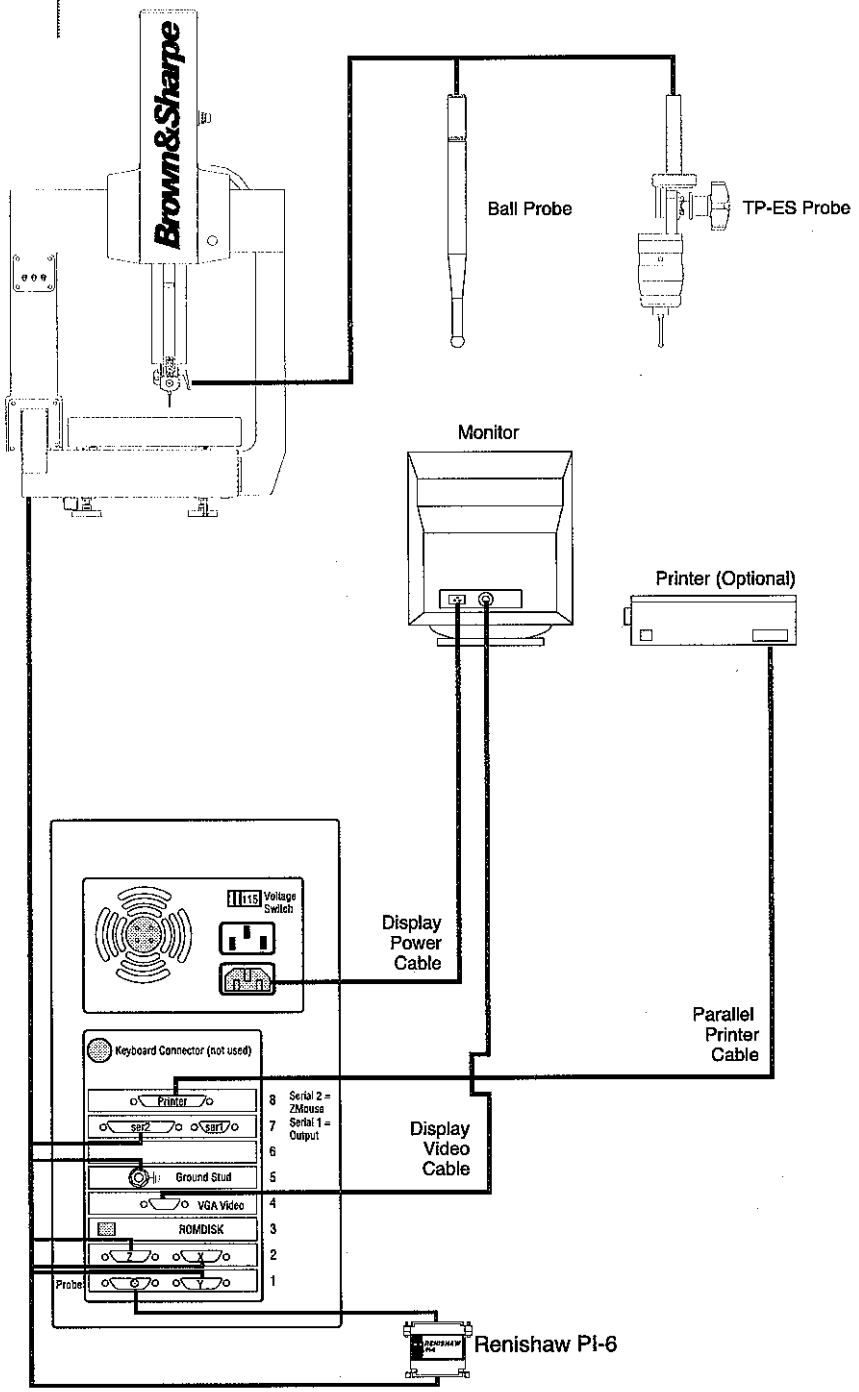
MicroVal 343 & 454 - System 1T Package



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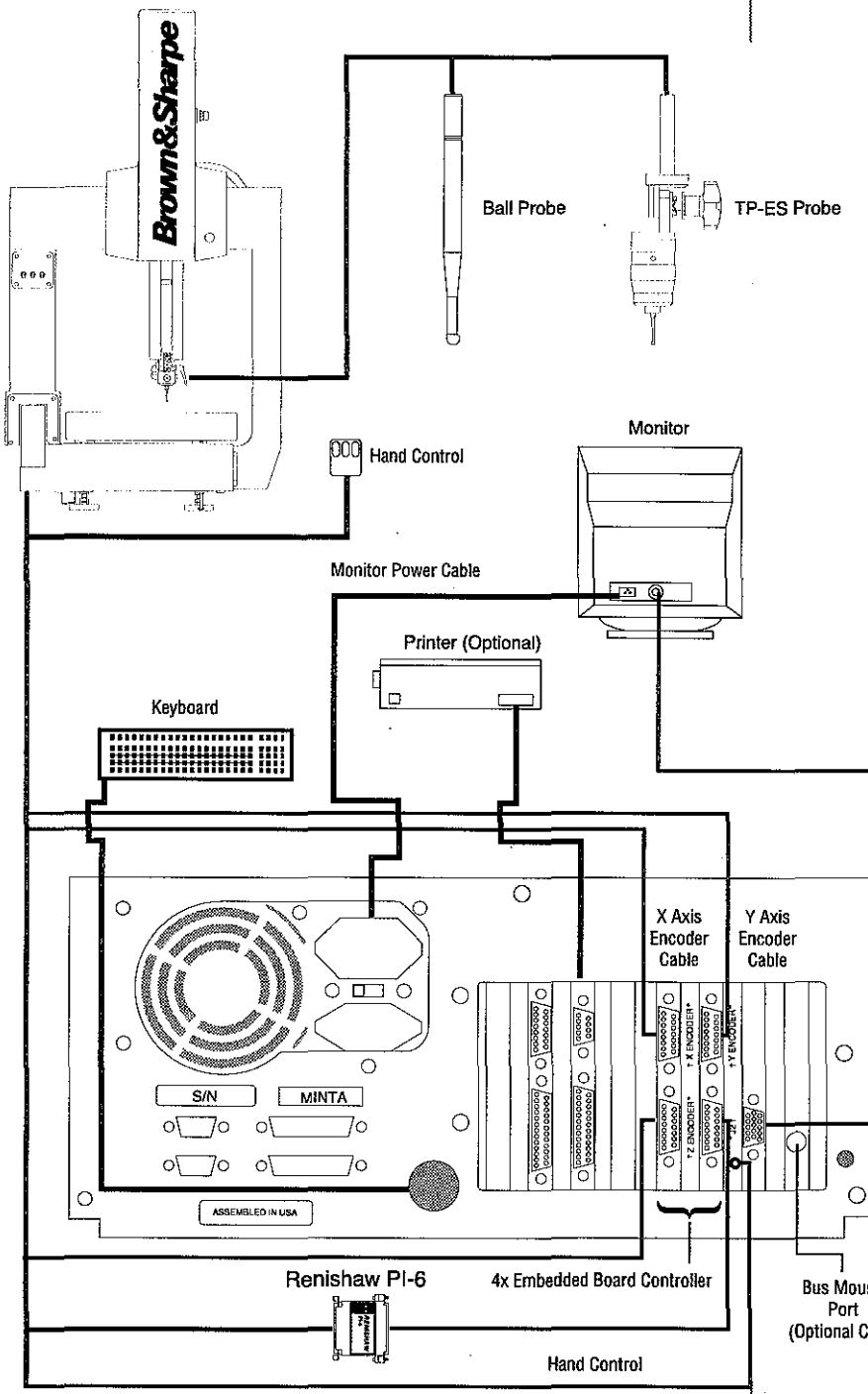
MicroVal 343 & 454 - System 3B/3T/4C/4MB Packages



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MicroVal Notes

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CHAPTER 3

Operati

Operator Safety

The following are safety instructions that apply to the operation of the machine. These instructions should be supplemented by the safety instructions of your company/organization.

Every effort must be made to keep your machine safe. A daily safety inspection should be made in addition to the normal maintenance inspection. Machine operators should be aware of safe operating procedures and apply these procedures at all times during operation. **Particular emphasis should be placed on ensuring that all guards are on the machine, in good condition and fastened securely. Never operate the machine when its guards are removed.**

The MicroVal has been designed to minimize possible hazards to the operator and sources of damage to the machine. While it is impossible to anticipate every situation, strict adherence to the safety rules in this manual will reduce the possibility of injury to personnel and damage to the machine.

- Develop personal safety awareness. Observe all safety regulations and be alert for hazardous conditions. Discuss these conditions with your supervisor. Use the personal protective equipment specified by your employer. Brown & Sharpe and the National Safety Council recommend the use of safety glasses with side shields for all personnel in the machining area.
- Never remove Warning and/or Instruction plates from the machine.
- Never wire, fasten, or override any interlock, overload, disconnect, or other safety device to void its assigned function. These devices are provided to protect the machine operator and the machine.
- Do not load, unload, operate, or adjust this machine without proper instructions.
- If you are uncertain about the correct way to do a job, ask for instructions before proceeding.
- Always lock the machine axes when leaving the machine unattended.

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Operator Safety

- Always lock the machine axes when leaving the machine unattended.
- Make sure the machine is properly located and secured. Allow sufficient access to the machine to prevent the danger of contacting other machinery.
- Ensure that all external cables are contained in their flexible cable guides.
- The electronics cabinet houses terminals that carry up to 220 VAC. Shock hazards are present. Even **low voltage shocks can cause death.** Make sure service is properly grounded. Be sure the electrical power cord plug and receptacle are provided with a third terminal ground connection.
- Always keep the machine's electrical cabinet closed. Allow only authorized electrical maintenance personnel access to the electrical cabinet.
- Never route cords across aisles or through water or oil. If using extension cords, regularly check for worn insulation or exposed wires. Never use defective cords.
- Never touch electrical equipment when hands are wet. Never activate electrical circuits while standing on a wet surface.
- Be sure the main air line is securely attached to the air supply system inlet port.
- Police the work area. Remove any tools left on the machine. Tools should be returned to their box after each use. Tools or materials scattered around are a leading cause of damage/injury.
- Keep the machine clean. The work areas around the machine should be clear of oil and chips. Clean the machine as required. Inspect daily for loose, worn or damaged parts.
- Never overload the machine. Always operate within the specified size and weight limitation. (See specification section of this manual).
- Always use power equipment to lift or move heavy inspection piece into the work area.
- When lifting parts onto and off of the machine always ensure a safe escape route in case the lifting apparatus fails
- Be careful when handling workpieces. Cutting operations produce sharp edges.
- Load heavy parts in the center of the table if possible.
- Before mounting work holding devices or workpieces, be sure that all mounting surfaces are clean and free of chips.
- It is good practice to avoid loading and unloading parts over the rails.

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Operator Safety

- Never lay tools on the machine where they can interfere with its operation.
- Before using the machine, look for workpiece or other obstructions.
- Report any unusual noise from the machine. Defects should be repaired immediately. **Never operate the machine in a defective condition.**
- Before mounting work holding devices or workpieces, be sure that all mounting surfaces are clean and free of chips, particularly the bearing surfaces.
- Keep hands away from all guards and openings in covers when moving the bridge or carriage.
- Tables, rails, housings and their related parts can create pinch points. Be sure you are clear of such locations before operating the MicroVal.
- Never remove WARNING and/or INSTRUCTION plates from the machine.
- During service, it may be necessary to remove or open some guards. If so, use great caution around exposed mechanisms. Make sure all guards are returned and in place when set-up work is completed.
- Do not allow the bridge, carriage or rail to impact the end stops with a high amount of force at the ends of the measuring range. Bring the machine to a gentle stop.
- Do not allow the probe body or Z-rail to strike the workpiece or work table.
- Do not allow the probe to strike the workpiece with high force. Reference the probing technique section of this manual.
- Do not attempt to move the bridge, carriage, or Z-Rail while air pressure is below the value listed in the specification section. Serious damage to the machine will result. Do not attempt to move the machine with the axes switches down.
- Always hold the Z rail firmly when unlocking the Z axis lock.
- Lock the machine axes when the machine is not in use.

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Computer Disks

A floppy disk is a reusable storage device that holds information, like software and data. The amount of space on a disk is measured in bytes. The information on the disk is not volatile and is not deleted when the computer is turned off. If you choose to, you can delete the information on a disk, and use the disk over and over again.

There are two kinds of disk drives: a *hard disk drive* and a *floppy disk drive*. A hard disk drive contains a nonremovable disk built into your system. With a hard disk drive, you can store large amounts of information in one convenient place, instead of storing it on many floppy disks. The storage capacity of hard disk systems is measured in terms of Mega, or million, bytes (Mb). For example, a 40 Megabyte (Mb) hard disk drive has a storage capacity of approximately 40 *million* bytes. The read and write speeds to and from a hard disk drive are much faster than those of a floppy drive. While under normal operation, the information on a hard drive is not considered volatile, the rare occurance of a hard drive failure can result in the loss of valuable information. For this reason, all important information/files should be copied or backed up to floppy disks.

A floppy disk is a reusable storage device that holds information, like software and data. A floppy disk drive holds a removable floppy disk, which has less storage capacity than a hard disk. The information on the disk is not volatile and is not deleted when the computer is turned off. If you choose to, the information on the disk can be deleted and the disk be reused. Storage capacities of floppy disks are measured in either Kilo, or thousand, bytes (Kb), or Megabytes (Mb). Presently, 3.5" floppy disks store 1.44 Megabytes (Mb) of information. When your system writes or reads information to or from a disk, the indicator light on the drive goes on.

While the information stored on a floppy disk is not volatile, the information on a floppy disk can be lost if the disk is handled improperly. The 3.5" floppy disk is protected by a hard plastic cover.

Because of the fragile nature of magnetic media, always make backup copies of your information. If you are storing important data to your hard disk, make a backup onto a floppy disk. If you are removing data from your hard disk and storing it on floppy disks, make two copies of the data. In general, always make a backup of important information. Backups should be stored separately from the original. Time invested in making backups will pay for itself.

Label each floppy disk so that you can identify the information stored on it. Place the label on the front of the disk, at the top, so that the label does not stick to any of the exposed areas of the disk.

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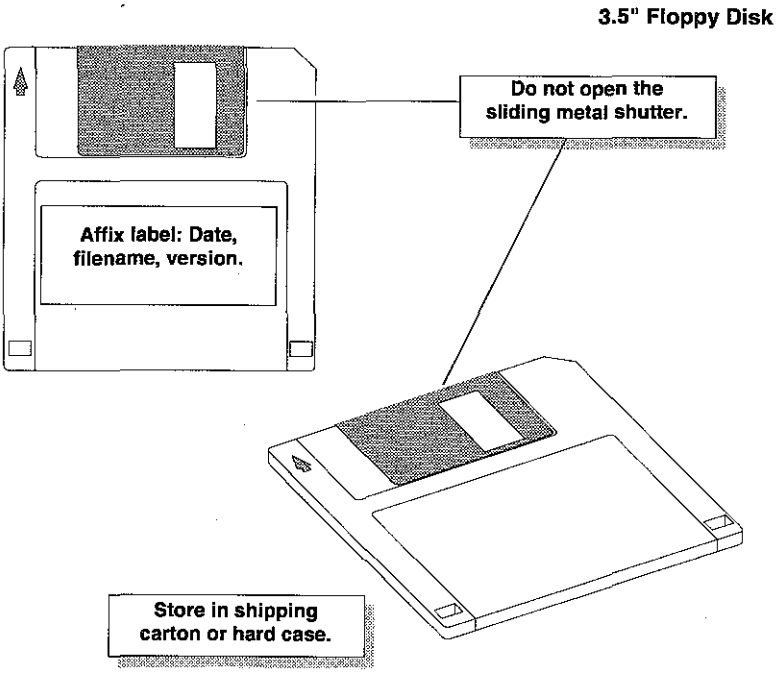
Computer Disks


3.5" Floppy Disk
Do not open the sliding metal shutter.
Affix label: Date, filename, version.
Store in shipping carton or hard case.

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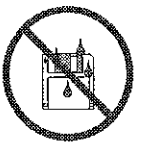
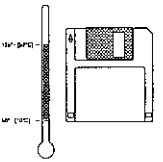
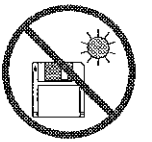
Use & Care: Computer Disks

To ensure the integrity of the data on your disk and to prolong a floppy disk's life, the following rules should be adhered to:



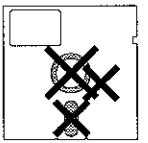
- Store floppy disks in a safe place, away from dust, moisture, magnetic fields (such as televisions, speakers and computer monitors).

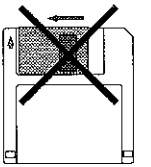




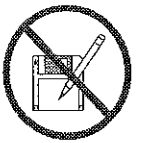
- Do not expose floppy disks to extremes in temperatures or excessive sunlight.

- Do not bend or crush floppy disks.





- For 3.5" disks, never open the diskette shutter.
- Do not drop floppy disks.
- Insert floppy disks carefully into the disk drives of the machine.



- **Never write on a disk.** It is better to write out a fresh label, then affix it.

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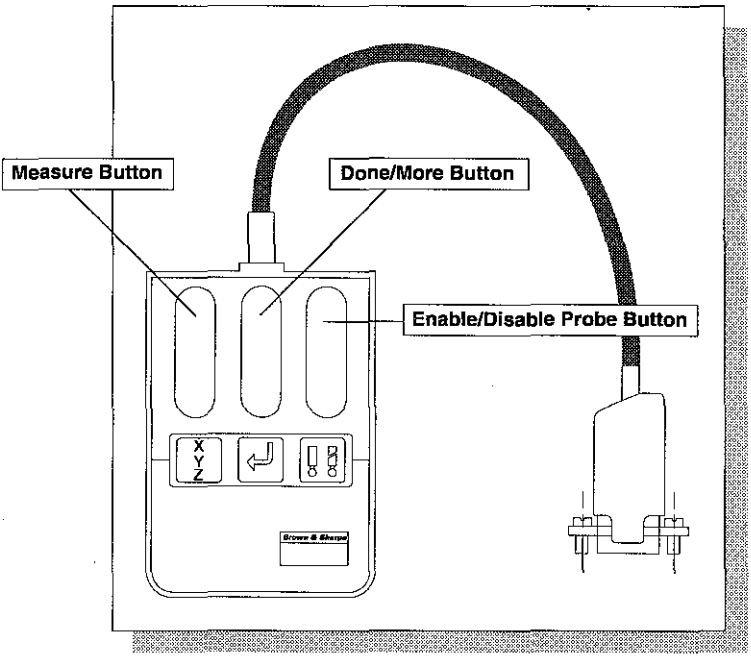
Remote Hand Switch (Optional)

The functions of the remote hand switch:

- The MEASURE button is used to measure or record the current X, Y and Z machine position. This is referred to as taking a hit.
- The DONE button fulfills a dual function. This button functions the same as the DONE softkey to end a measurement. It will also function the same as the MORE softkey, if activated in the Print Preview screen. In this case, it will give an additional measurment of the same type or current type, s uch as another Circle measurement.
- The ENABLE/DISABLE button activates/deactivates the touch trigger probe (TTP).



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Using A Desk Mouse

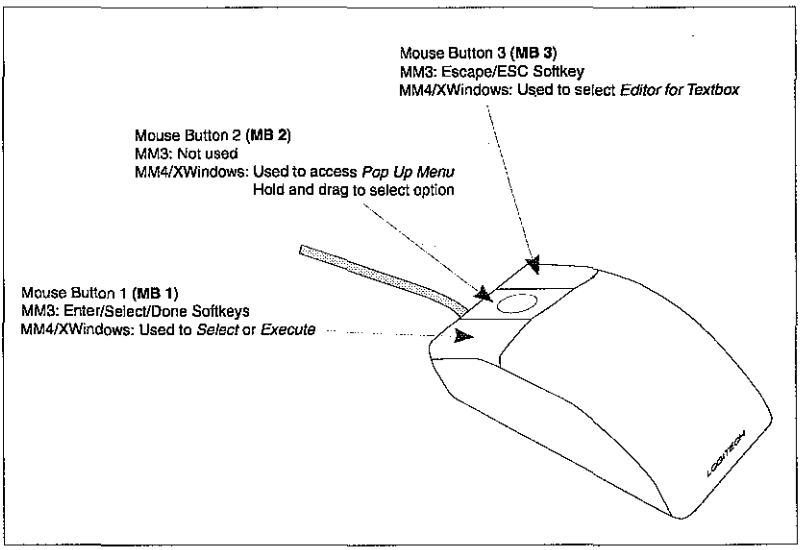
An important tool in using MicroMeasure is the mouse. The mouse allows you to select items by pointing at them. If you have never used a mouse before, you may need a little practice to get comfortable with it. For the best control of the mouse, hold it with the cable pointing away from you.

Without pressing any buttons, move the mouse around slowly and watch for a small shape that moves on the screen. This shape is called the mouse cursor. When you move the mouse on your desk, the mouse cursor makes the same movement on the screen. If you run out of room, you can pick up the mouse and place it on another spot. The pointer on the screen will not move while the mouse is off the pad or another surface.

Notice how the mouse cursor changes shape when it is in different places on the screen (MM4 only). The shape of the mouse cursor indicates what the mouse is ready to do. Refer to your software reference manual for further information.

In MicroMeasure, you press the mouse buttons to interact with different items on the screen. First you move the mouse cursor to the item that you want, such as a window or an icon. Then you click a mouse button to initiate some action involving the item. An action is initiated by releas*ing*, not pressing, the mouse button on that item. Each button performs different functions.

Button 1:
For right handed mice, Button 1 is the leftmost button. It is used for all MicroMeasure IV and X Windows functions. This button will also open the Workspace Menu when the cursor is in the X Root window. In MicroMeasure III, this button is equivalent to Select/Done/Enter and selects the highlighted feature even if the cursor is not on it.


Mouse Button 3 (MB 3)
MM3: Escape/ESC Softkey
MM4/XWindows: Used to select Editor for Textbox
Mouse Button 2 (MB 2)
MM3: Not used
MM4/XWindows: Used to access Pop Up Menu
Hold and drag to select option
Mouse Button 1 (MB 1)
MM3: Enter/Select/Done Softkeys
MM4/XWindows: Used to Select or Execute
LOGITECH

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Using A Desk Mouse

Button 2:
For right handed mice, Button 2 is the center button. When the cursor is placed over a window frame, this button opens the System Menu Window, shown below. This is the same as pressing the System Menu Window button that appears in the upper right corner of most windows in X Windows. A powerful feature of button 2 is its ability to "paste" items highlighted using button 1. In MicroMeasure III, this button is not used.

Button 3:
For right handed mice, Button 3 is the rightmost button. This button opens the System Menu Window. This is the same as pressing the System Menu Window button that appears in the upper right corner of most windows in X Windows. In MicroMeasure III, this button is equivalent to ESC/Escape.

The cursor sensitivity of the mouse is adjustable. In MicroMeasure 3, the cursor sensitivity is set within the AUTOEXEC.BAT file of your computer.

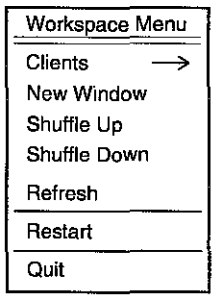
In the AUTOEXEC.BAT, the line:

LOADHIGH C:\BUSMOUSE\MOUSE.* sØ5 bus**

loads the mouse driver. The number after the s controls the cursor's sensitivity. A value of 0 is the least sensitive (or slow), while a value of 10 is the most sensitive (or fast).

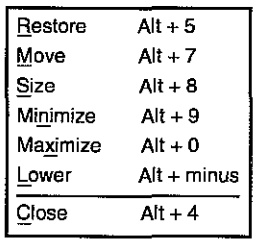
In MicroMeasure IV, the cursor sensitivity is set in the startup file. Call Brown & Sharpe for help to adjust the cursor speed.

- Double click (two fast mouse clicks) using the button 1 on an input field. The input field will change from yellow to black.
- If you type while the field is highlighted black, all text in the input field will be replaced with what you type.



Using the mouse you can copy values from one field and paste them into another field.

- Double click on the field to be copied. The input field will change from yellow to black.
- Press the middle mouse button (button 2) on the target field (the field to receive the information). If the target field already contains some text, the copied text will be inserted after the text cursor. To replace the entire contents of the target field with the copied filed, you must first delete all the information in the target field.



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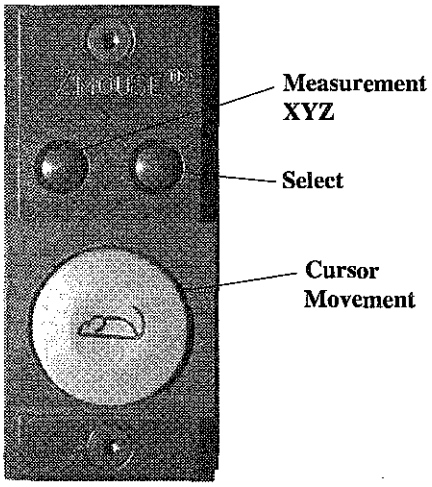
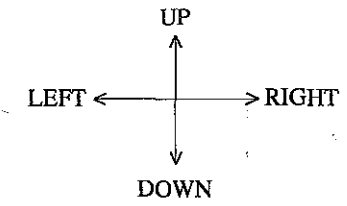
Using A Zmouse

The Zmouse is similar to the desk mouse in that it moves a selection cursor on the screen. The direction of motion is defined by the direction that the cursor button is pressed (top of the button to move the cursor up, bottom of the button to move the cursor down, etc.). The speed of the cursor is determined by how hard the button is pressed. The cursor stops moving when pressure is removed from the cursor movement button.

The Select button is used to activate a menu item highlighted by the cursor. The Measurement button is used to record a measurement point.





Cursor Movement

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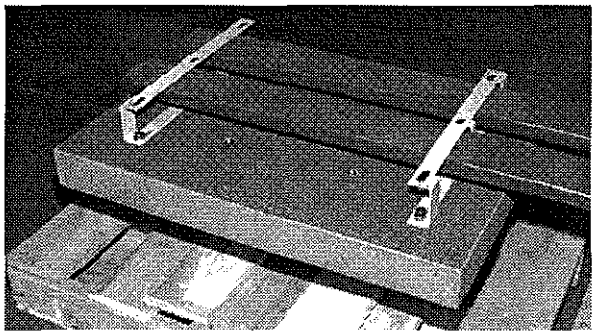
Starting & Stopping

Make sure that the following steps have been taken before starting the machine:

- Check the packing list to ensure that all necessary items have been received.
- The machine and workstation is in a thermally stable environment (see Specifications).
- The machine has been leveled such that the bridge does not drift when all axis lock switches are unlocked and the probe holder is not being held.
- Check to ensure the machine was installed according to the specifications in the Installation Manual.
- Verify that all shipping brackets (yellow) have been removed.



- Check the *input air supply* pressure. It should be between 70 and 120 psi (4.9 to 8.2 BAR) and should provide for a minimum consumption of 3.5 SCFM (100NL/min). The pressure should be relatively constant and not subject to drastic changes. The air supply should also be relatively free of contaminants. NOTE: The maximum air pressure is 120 psig (8.2 Bar)
- The air supply is connected and the regulator is factory set to the correct pressure. The pressure gage displays 55±1 psi (3.7 BAR). The pressure has been preset at the factory. If the pressure is not correct, unlock the knob at the bottom of the regulator, adjust the pressure, and relock the knob.
- All cables from the machine to the 1T or embedded controller (ie. RS-232, hand control, encoder cables, mice, display, etc.) are connected (reference schemtatics).
- The computer system software is installed (if included) and the cables (ie. PC, printer, display, mice, etc.) are properly connected. (reference schematics). For additional information about peripheral equipment, such as computers, printers, etc., refer to the manufacturer's technical publications for operating procedures.
- Verify that all machine guards and covers are in place.
- Wipe all exposed ways and the table work surface with alcohol and a clean, soft cloth to remove dust or residue. (Reference the Cleaning Bearing Surfaces in Preventive Maintenance Section)

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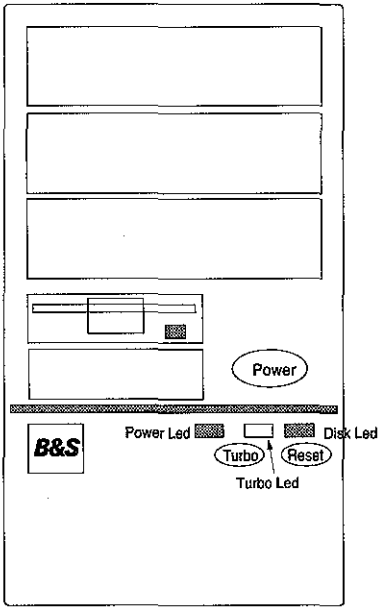
Starting & Stopping

- Verify that the machine is properly grounded. Plug the power cords for the MAN4 controller (if applicable), any probe accesories, and any computer equipment supplied with your machine (if applicable) into a power supply that agrees with the specifications in the Installation Manual.
- Power up the machine. For machines with the MAN4 controller, push the front panel switch on the controller. For machines with an embedded board controller, turn on the computer.



- Turn on the computer system and its peripherals, if not on already.
- After the computer has booted, start your measurement software. Depending on how your computer system is configured, this may be done automatically.
- The CMM's system parameters will be downloaded from the computer to the CMM. This may or may not be done automatically, depending on your software.

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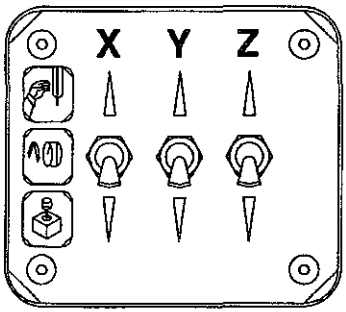
Moving the Axes

A position at the front of the machine is a comfortable one for most operations. This permits easy access to the measuring envelope while watching the video monitor.

The movement of each axis through the measuring envelope is accomplished by pushing or pulling on the Z-rail. The Z-rail has finger pads at its lower end for gripping. Stops are provided at both ends of the three axes to prevent overtravel. Care should be taken to slow down when approaching the stops to prevent banging.



On the MicroVal each axis is provided with a locking system. This system consists of three switches, mounted on the left leg, that control the flow of air to the locking air bearings. Turning a switch to "off" (down) deflates the preloaded air bearings for that axis and locks the axis.

The Z-rail counterbalance system equalizes the weight of the rail so that it moves easily up and down. The regulator that controls the counterbalance is located at the right side of the ZX carriage. It must be adjusted to compensate for varying probe weights. If the counterbalance pressure is adjusted too low, it will trigger the safety valve causing the Z-axis bearings to deflate and lock.

CAUTION

On the MicroVal do not attempt to move any axis with the air supply to that axis turned off.

Do not attempt to adjust the Z-rail counterbalance with the axis locked. Hold the Z-rail firmly when unlocking the Z-axis. The rail, if not properly adjusted, may move suddenly when the axis lock is released.

On the MicroVal 454, the axes can be precisely adjusted by means of a rod and bearing arrangement that acts like a fine pitch screw. The rod is turned by means of large, knurled knobs mounted on both ends of the X-axis and Y-axis and at the lower end of the Z-axis. There are switches on each of the individual fine adjust mechanisms that are used to engage or release the mechanism.

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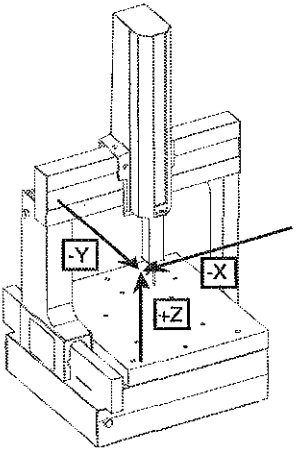
Homing the Machine

The home position for the MicroVal is in the upper front left corner of the machine. Before any measurements can be made, the machine must be moved to its home position and that position must be recorded in the software. This is so that the machine has a reference position to which it can relate all axes movements.

- To home a manual MicroVal, release the axis lock switches so the machine floats freely. *Slowly* move the Z axis to its highest point where it will hit the Z axis end of travel stops. You do not want to slam the axis against the end of travel stops. *Slowly* move the ZX carriage in the -X and -Y directions until you hit the stops for the X and Y axes in the front left corner of the machine. Without moving the machine, relock the axis lock switches. You will have to tell the measurement software you are using that you are now in the "Home" position. This process varies from program to program.

- Clean the reference sphere and mount it to the table. Be sure the connections are tight. It should always be positioned where it will not interfere with the mounting or measuring of workpieces.

  NOTE: After the reference sphere has been located using the following technique, the reference sphere should not be moved!



NOTE: The boxed letters refer to the movement necessary for the Bridge/XZ-Carriage/Z Rail to reach the "home" position.

If Your System Is Running MicroMeasure II++ or III,

- Access the Reference Sphere screen (reference the MM3 Tutorial). Enter a reference sphere diameter, if the one you are using is different from the one shown on the screen.
- Remove the probe from the probe holder if one is installed.
- Unlock the machine's axes and move the probe holder/Z rail above the reference sphere.
- Place and hold the probe holder on the reference sphere so the sphere is seated in the hole for the probe.
- Press the DONE softkey, handcontrol or mouse. The qualification screen will apprear.

For more information regarding location of the reference sphere using MM3, refer to "Install the Reference Sphere" in the MM3 Tutorial.

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Homing the Machine

- Reattach the probe to the probe holder.
- Adjust the Z Axis counterbalance for your probe. It should be adjusted so the Z rail does not rise or fall when the probe holder is not being held.
- Qualify your first tip.
- Verify that the offsets and home position are correct by moving the machine back to the home and reading the machine position. The machine position (X,Y,Z) will be the current probe offsets.
- Mount the workpiece if one is not already mounted to the table.
- Begin the measurement session.
- If the machine is to be stopped overnight or longer, it is recommended that the air supply be shut off. Whenever the machine is left unattended, the axis lock switches should be placed in the Fine Adjust or "locked" position to prevent inadvertent operation.
- After a power loss, the procedure for starting is the same as above. If your computer was running when the power loss occurred and has a UNIX operating system, the following (or a similar) messages will appear:

```
fsstat: root file system needs checking
OK to check the root file system (/dev/root):
```

  Always answer (in lower case) **y** to this prompt, as UNIX will attempt to correct whatever damage it can, and then report errors that it was not able to fix. The following message will also appear:

```
Set filesystem to okay?
```

  Always answer (in lower case) **y** to this prompt. UNIX will complete repairs and then continue the boot sequence.
- After a power loss, the machine homing sequence must be repeated.
- It is recommended that the power switch be left ON at the end of a shift. Remember, whenever the machine is left unattended, the axis lock switches should be placed in the Fine Adjust or "locked" position to prevent inadvertent operation.

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The Inspection Process

The first step to approaching a measurement is to review the print or drawing and identify all dimensions which must be verified. One prefered method is to highlight all dimensions which must be verified. Once a good understanding of the measurement task is in place then the setup and fixturing can be identified.

To mount a workpiece for measurement:

- Remove all obstructions from the MicroVal's work table.
- Ensure that the part to be measured does not exceed the machine's weight or size capacity.
- Locate the part within the measuring envelope of the MicroVal, ensuring that the sections to be measured are within the probe measuring range and as close to the operator as possible. If table clamps are used, try tolocate the workpiece conveniently with respect to the M10 threaded table inserts

> **CAUTION**
>
> Do not overtighten clamp bolts or the threaded table inserts may pull loose from the granite table. The maximum allowable torque on the bolts is 15 ft. lbs.

Clamping is a very important aspect of planning a measuring strategy yet it is often overlooked. Incorrect fixturing can lead to part deformation and use up a significant portion of the part tolerance. The problem is magnified with temperature variation during the measurement period. It is impossible to define a generic method for fixturing parts since this will vary due to part geometry, material, cross section, etc. Let it surfice to say that the clamping or fixturing method deserves serious consideration when creating an inspection plan. There are many articles available on designing kinematic clamping / fixturing systems.

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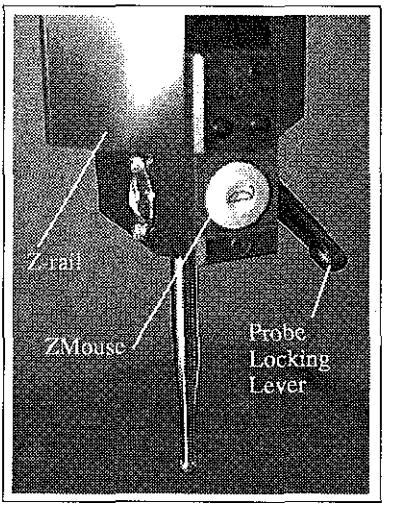
Probe Installation

The Z-rail has a probe holder built into the bottom of the rail. To install a hard probe:



1. Loosen the locking lever on the side of the Z-rail.

2. Insert the probe shank into the Z-rail. A spring plunger detent will help to hold the probe in place (the probe tip is normally 3" (75mm) from the end of the Z-rail).

3. Tighten the locking lever. Be sure the probe is firmly clamped.

4. Adjust the Z-rail counterbalance control to compensate for the added weight of the probe. Unlock the Z-axis. Unlock the counterbalance regulator by pulling the knob outward. Turn the knob clockwise to increase the lift for heavy probes or counterclockwise for light probes. When finished, push the knob in.

To install a Touch Trigger Probe:

1. Loosen the locking lever on the side of the Z-rail.

2. Check the Touch Trigger Probe to be sure it has a stylus tip. If not, obtain the required tip and install it onto the probe head sensing shaft, securing the tip with the stylus tool provided. Refer to the probe manufacturer's documentation for stylus installation instructions.

3. Insert the probe head mounting shaft into the Z-rail until it engages the detent.

4. Rotate the probe head until the red light indicator faces the front of the machine.

5. Hold the probe in this position and tighted the locking lever until the probe is firmly clamped.

6. Connect the probe head lead to the probe connector located on the Z-rail.

7. If necessary, adjust the Z-rail counterbalance control to compensate for the change in weight from the probe. The proper tip type must be selected in the configure screen.

Note: These probe installation procedures are typical and included as an example. The procedure for installing your probe may differ from these. Refer to your probe manufacturer's documentation for installation instructions.
Note: Each tip must be qualified before it it used for measurements.

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Measuring With a Ball Probe

Qualifying Probes

All probes must be qualified before accurate measurements can be made. There are two primary purposes for this:

- To calculate the effective tip diameter.
- To learn the location of the center of the probe tip in the measuring volume. This is important to obtain properly compensated data when the positional feedback is filtered through the error map.

Before qualifying a probe,

- Verify that the proper probe type is selected in the software.
- Verify the probe shaft diameter for your machine.
- Verify the reference offsets for your probe.
- Verify that the qualification or reference sphere diameter is correct within the software configuration.

Refer to your software manual for a detailed description of the probe calibration process.

To measure with a ball probe, firmly hold the Z-rail and gently make contact with the surface of the part with the ball probe. Be sure there are no vibrations or bouncing and that the probe has come completely to rest against the part. To measure a point with a hard ball probe, bring the probe into contact with the part surface and press the "Measure" button on the 3 button hand control. On the 1T machine without a hand control, use the Measurement XYZ button on the ZMouse to record the point measurement.

The measurement software continually monitors the measuring direction or "sense" and automatically corrects or "compensates" for the probe radius.

The measurement software also continually monitors the location of the measurement point within the measuring volume . The "approach" vector, or the vector created from the last monitored point to the first measurement point, is of critical importance for all features. For planar surfaces, the approach vector is used in the calculation of the positive direction of the feature's vector. The approach vector should be as perpendicular to the feature's surface as possible. After the first point is taken, it is OK to slide the probe on the feature's surface between taking points.

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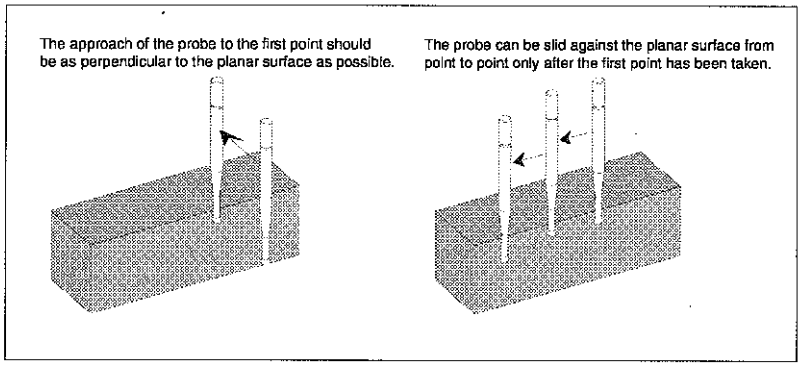
Probe Compensation

"What is probe compensation?" When a point is measured with a probe, the point recorded is at the *center* of the probe, not on the *surface* of the probe. Probe compensation is the process of calculations that corrects the measured feature for the probe radius error. **The approach vector for the first point of a feature is used in these calculations and is thus of critical importance.**

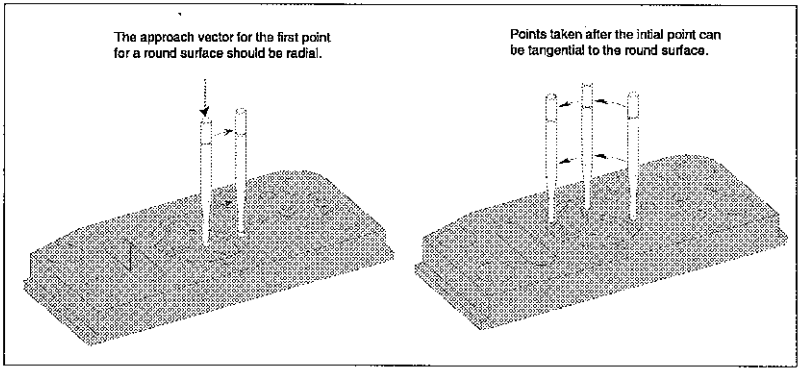
The approach vector determines:

- The direction of probe radius compensation during measurement calculations
- A plane's vector direction
- Which bonus tolerance calculation to use when true position tolerancing circular features

Taking Points With a Hard Probe Against a Planar Surface


The approach of the probe to the first point should be as perpendicular to the planar surface as possible.
The probe can be slid against the planar surface from point to point only after the first point has been taken.

Taking Points With a Hard Probe on a Round Surface


The approach vector for the first point for a round surface should be radial.
Points taken after the intial point can be tangential to the round surface.

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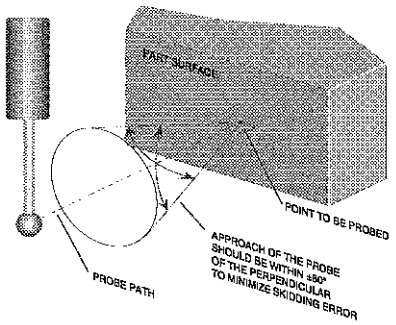
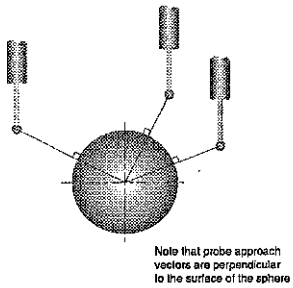
Measuring With an Electronic Probe

NOTE: Carefully read the probe user's guide before attempting to use the probe.

Measurement points are recorded when the stylus is deflected enough to either break mechanical contacts or generate enough force to trigger pressure sensitive circuitry. This generates a signal to the controller, which latches the counters and records the "point". For manual measurements, the operator must be careful to take measurement points at a velocity which will not create damage to the probing system.


PART SURFACE
POINT TO BE PROBED
APPROACH OF THE PROBE SHOULD BE WITHIN ±30° OF THE PERPENDICULAR TO MINIMIZE SKIDDING ERROR
PROBE PATH



The arrangement of the contacts does cause slight errors in probing. These are reduced during probe qualification. However, the longer the probe tip extension, the larger the pre-travel error and the more residual error is left after probe qualification. Also, longer probes tend to be not as stiff as shorter probes. The more a stylus bends or deflects, the lower the accuracy. Therefore, probing with very long stylus/extension combinations should be avoided.

Probe hits (also known as "points") should be taken perpendicular to the part surface wherever possible. If hits are not taken perpendicular to the part, skidding may occur. Skidding (probe tip sliding on the part as probe contacts are disturbed) produces inconsistent and non-repeatable results. If probe hits are taken within 20 degrees of perpendicular, skidding errors will be much less than one micron (0.000040 in.).

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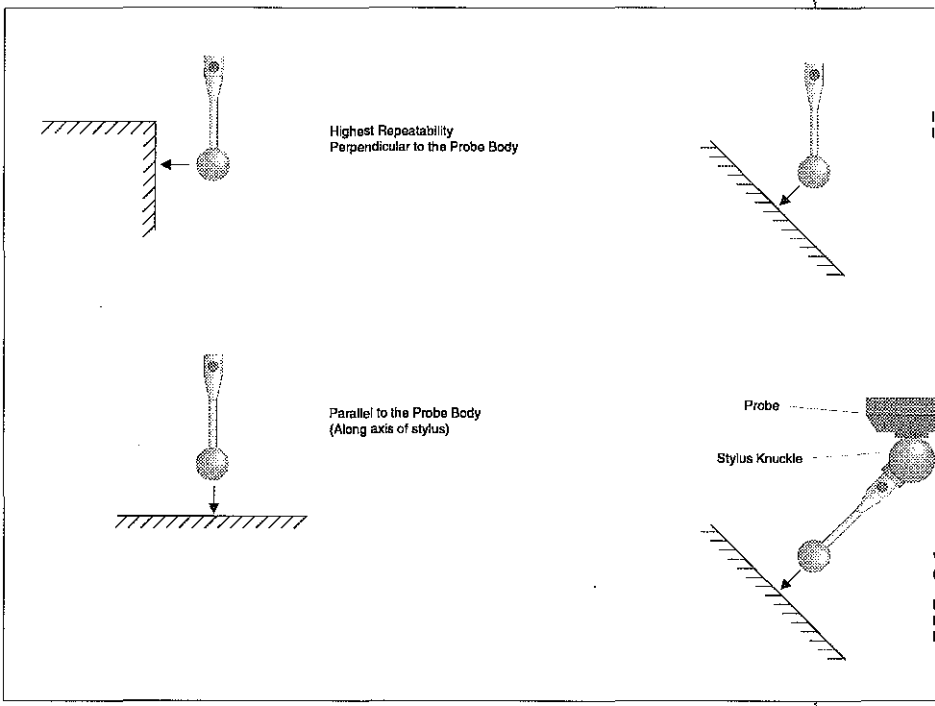
Touch Trigger Probe Repeatability

The touch trigger probe is designed to give optimum results when the probe hits are taken perpendicular to the probe body (perpendicular to the axis of the stylus). Wherever possible make hits perpendicular to the probe body. Probe hits taken parallel to the probe body (along the axis of stylus) give results that are not as repeatable as those taken perpendicular to the axis. Probe hits neither perpendicular nor parallel to the probe body give results that are less repeatable as those taken parallel to the probe body. Probe hits taken parallel to the stylus axis, but at an angle to the probe body, are not repeatable and should be avoided if possible.

Probe configurations causing triggering forces which are neither parallel nor perpendicular to the probe body should be avoided.



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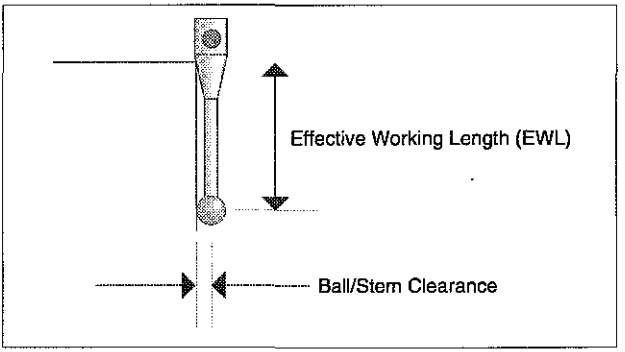
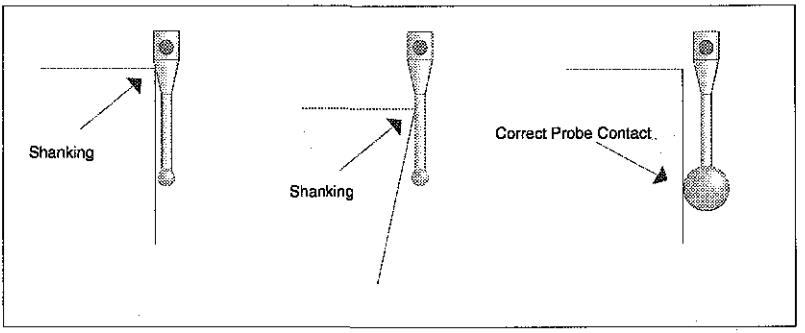
Touch Trigger Probe Repeatability

Another possible cause of error is shanking, when the probe contacts the part with the shank of the stylus and not the tip. The measuring system will assume the hit was taken with the tip and large errors will occur. Increasing the diameter stylus ball increases the ball/stem clearance and lessens the likelihood of shanking. The Effective Working Length (EWL) is the depth that can be achieved by the stylus before its stem fouls (or shanks) against the feature. Generally the larger the ball, the greater the EWL. Using a larger stylus ball also reduces the effect of surface finish of the component being inspected, however, the largest ball which can be used is limited by the smallest hole to be measured.



The probe should be treated as a precision measuring instrument. Keep it free of dirt and handle it with care to ensure it maintains it's size and shape.

The stylus is made of industrial quality ruby that is very hard and provides good wear resistance. The stylus ruby tip should always be kept free of contaminants. A one micron (0.000040 inch) piece of grime causes a one micron measurement error.



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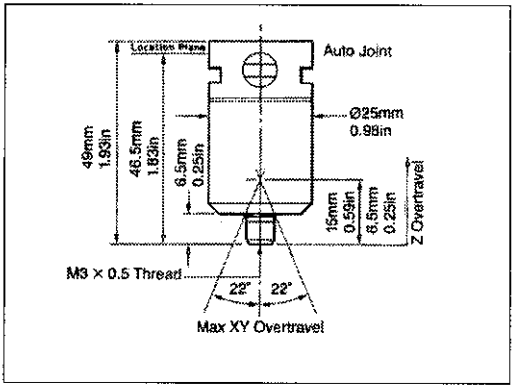
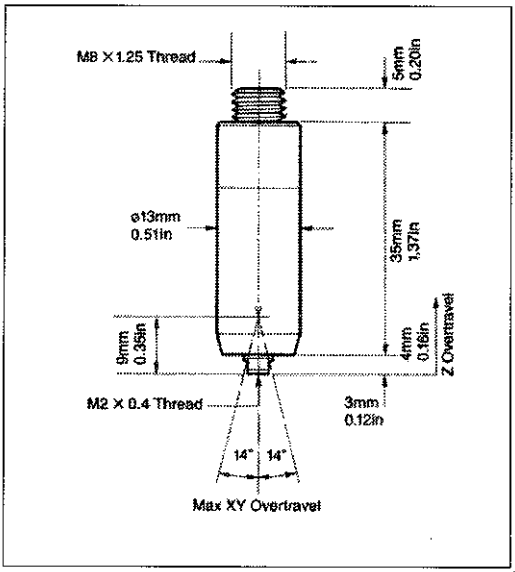
Useful Probe Dimensions

Renishaw TP6A Probe



Renishaw TP2-5 Way Probe



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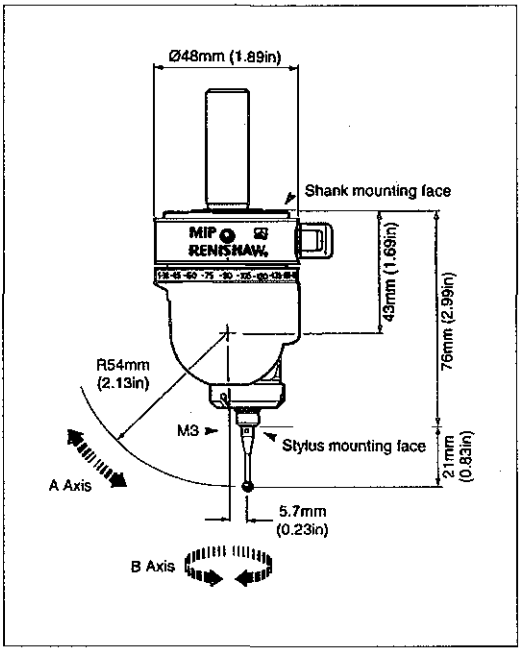
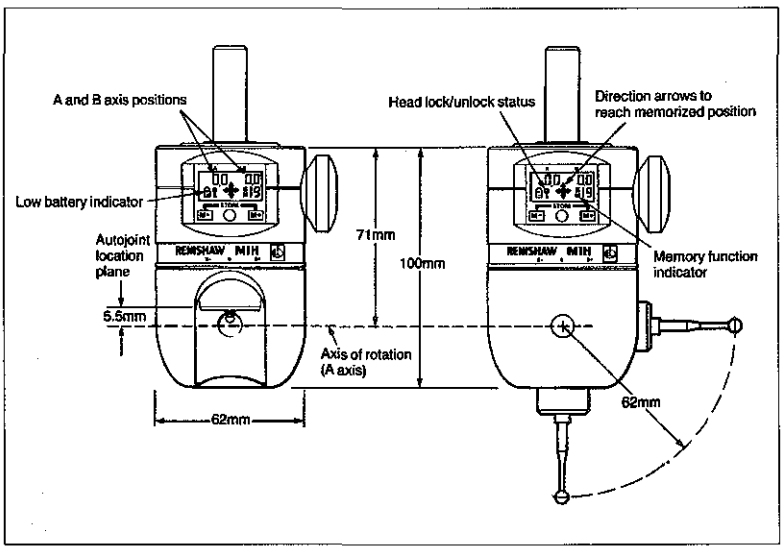
Useful Probe Dimensions

Renishaw MIP Manual Indexable Probe



Renishaw MIH Manual Indexable Head



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Good Measurement Techniques

The following are good techniques to use when operating the Microval as a manual machine:

- Operators should qualify their own tips because of differences in style.
- Verify probe offsets after qualification.
- Clamp the part so that it doesn't move when measuring.
- Hold the Z-rail on the pads and not on the bearing surface to prevent heat transfer to the machine.
- Be sure the part, the qual sphere and the stylus are clean.
- Recertify the qual sphere for size and form at least once a year. If the qual sphere is dropped, it must be recertified.
- If the granite is used as a datum it should be cleaned, periodically certified for flatness, and realigned with the machine's X and Y rail plane surface.
- Be sure the direction vector is correct when contouring with a hard probe or when checking a complex surface contour.
- Use a perpendicular approach vector whenever possible. Make your measurements perpendicular to a surface when contouring with a Touch Trigger Probe.
- The machine should be level to the floor and the granite level to the machine without anything on the granite.
- When checking close tolerances, the form of the ball probe should be checked.
- When qualifying with extensions that could affect accuracy, check with a ring gage. Use for interim gage checks or probing setup.
- When qualifying tips, check form error. If not within 4µm (.000015"), requalify.
- Don't use the machine or granite plate to rest on.
- Practice your measurement techniques. You need constant practice to get good results.
- Locate the reference sphere and allow it to stabilize before measuring.
- Check air pressure. An axis drag can affect machine performance.

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Notes

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CHAPTER 4

Mainten

Maintenance Safety

Proper maintenance, on a regular scheduled basis, is vitally important in a plant safety program. You should be thoroughly familiar with the MicroVal, including its controls, safety devices, and operation, before attempting any maintenance work. Since maintenance work often necessitates working on a machine with safety guards and covers removed, you should approach every job with the proper respect for established safety procedures.

Read this manual carefully before attempting any maintenance work on the machine. Failure to follow procedures recommended in the manual can result in injury to personnel or damage to equipment.

- If you are uncertain about the correct way to do a job, ask for instructions before proceeding.

- Your Brown & Sharpe machine represents a sizable investment. If maintained and used properly, it will provide you with many years of excellent service. We highly recommend that in its maintenance you use only genuine Brown & Sharpe replacement parts in the interest of long machine life, production efficiency and operator safety. Failure to do so may lead to unsafe operating conditions and will invalidate warranty agreements.

- Never remove the Warning and/or the Instruction plates from the machine.

- Never wire, fasten, or override any interlock, overload, disconnect, or other safety device to void its assigned function. These devices are provided to protect the machine operator and the machine.

- Use Isopropyl Alcohol as a solvent to clean the rails and worktable of the MicroXcel.

CAUTION

Never use carbon tetrachloride as a solvent for cleaning. Provide proper ventilation when chemicals and gases are used.

- Immediately report any unsafe practices or conditions you may observe.

- Make sure the machine is properly located and secured. Allow sufficient access to the machine to prevent the danger of contacting other machinery.

- Keep wrenches, tools and other miscellaneous equipment off the work table and aluminum rails. Avoid using the table as a workbench. Return tools to their box after each use. Tools or materials scattered around are a leading cause of damage or injury.

- Digging, grinding or chipping near the machine should be avoided.

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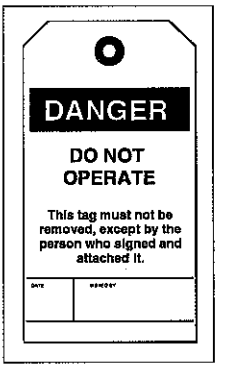
Maintenance Safety



- Disconnect all Power sources before attempting to perform maintenance or repairs. Make certain no one can turn power ON without your knowledge. Attach warning tags to prevent unauthorized use and/or unintentional start.
- The electronics cabinet houses terminals that carry up to 220 VAC. Shock hazards are therefore present. Even **low voltage shocks can cause death.** Make sure service is properly grounded. Always keep the cabinet closed.
- Never attempt to modify or rework the machine's electrical system.
- Allow only authorized electrical maintenance personnel access to the electrical cabinet of the machine.
- A good earth ground (less than 5 ohms) is required for relaiable operation of the electronic controls. It man be necessary to ground the machine to an independent ground level.
- This machine will operate satisfactorily at customer supplied line voltage levels within ±10% of the normal rating. Sharp line voltage changes such as those that could occur when a welder or large motor is applied to the line, can adversely affect machine operation and must be avoided.
- Never touch electrical equipment when hands are wet. Never activate electrical circuits while standing on a wet surface.
- Solid state control circuits require proper grounding and shielding. Ensure that all shields are properly connected after repairs. Any unauthorized addition to machine wiring invalidates machine warranty and may result in unexpected operation.
- During maintenance work, it may be necessary to remove or to open some guards. If so, take extra care because of exposed mechanisms. Make sure all guards are returned and in place when maintenance work is completed.
- When covers are removed, mechanical pinch points are exposed. Keep hands or loose clothing away from all mechanisms, even those at rest. Pneumatics
- Never use compressed air to clean dust and chips from machines. Vacuum type arrangements are best for these purposes.
- Pressure in the air system must be reduced to zero before the system can be opened.
- Do not attempt to move the bridge, carriage, or Z Rail while air pressure is off. Serious damage to the machine will result.
- Before repressurizing the system after maintenance, be sure the main air line is securely attached to the air supply system inlet port.

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Maintenance Intervals

This schedule of maintenance inspections must be followed to ensure continuous and safe operation of your machine. A maintenance log should be kept for each machine and all work and/or replacements recorded for future reference. Failure to follow this schedule will be cause for invalidation of the warranty. Any components not functioning properly should be adjusted for proper operation or immediately replaced.

Scheduled maintenance checks must be performed by assigning personnel who are thoroughly familiar with maintenance procedures. The more complex inspections must be done by trained maintenance personnel on a regular basis at the minimum intervals shown.

The recommended intervals for preventive maintenance are: Daily, Monthly, and Three Months. These intervals are based on eight hours per day and forty hours per week of machine operation.

If the machine is operated on longer or extra shifts or for more than five days per week, the maintenance schedule must be adjusted as follows:

- Daily or every 8 hours of operation
- Monthly or every 165 hours of operation
- Three months or every 500 hours of operation

For example, if a machine is operated for two eight hour shifts per day, the monthly maintenance should be scheduled every two weeks. If the machine is used less than eight hours per day or less than forty hours per week, the regular daily, monthly and three months schedules should be followed.

Copies of this Preventive Maintenance Schedule should be available to all personnel involved.

CAUTION

Turn Main Disconnect Switch to OFF, tag and lock when making adjustments, removing or replacing covers, guards and components and when making inspections requiring physical contact with the machine. Some inspections and adjustments require the Main Disconnect Switch to be in the ON position to provide necessary power. In such cases, use extreme caution to prevent injury.

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Maintenance Schedule

lours

Give the machine an overall check daily. Pay particular attention to the following steps:

1. Check guards and covers. Repair any that are damaged. Replace any that are missing.
2. Wipe all exposed air bearing paths and the work table surface with alcohol and a clean, soft cloth. Use clean medical gauze or the equivalent.
3. Check the air supply. It should be 55 psi (3.7 BAR).
4. Check the air filters and drain or replace, if necessary.

> **CAUTION**
>
> Never attempt to remove any portion of the filtration system without disconnecting the air supply to machine and bleeding off system pressure.

ours

1. Inspect the machine visually for loose, worn or damaged parts. Tighten any loose screws or nuts. Replace any that are missing.
2. Check air supply coalescing filter for buildup of water or oil. Press the rubber knob on the filter sideways and drain the filter as required (always wear safety glasses). The air supply must be on. If a buildup is constantly found, installation of additional filtering or an air drying system may be required.
3. Check the cable and cable connections for the Z-axis counterbalance.
4. Check electronic probes and cables.
5. Check measuring scales.
6. Check air system.

hs or 500

1. Visually check the electronic cabinet for dirt, oil or water and for loose wires or damaged insulation.
2. Check all machine functions to ensure proper and accurate operation. A simple program to test the repeatability, machine geometry and linear accuracy is recommended.
3. Check the cable connections on the machine and at the electronic cabinet. Be certain cables are fastened and safely routed to prevent accidents.
4. Check the air system for loose or cracked lines.
5. Check that the machine is level.

> **CAUTION**
>
> Hazardous Voltages exist inside the electronic cabinet. Service must be performed by trained, authorized personnel only. Use extreme caution in making tests and adjustments. Safety glasses should be worn while servicing the electronic cabinet.

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Maintenance Log

Daily

- ☐ Check guards and covers
- ☐ Wipe ways and table
- ☐ Check measuring scales and clean if required
- ☐ Drain coalescing air filter
- ☐ Check air supply
- ☐ Check machine functions
- ☐ Check regulator pressure

Monthly

- ☐ Inspect machine for loose, worn or damaged parts
- ☐ Check air filters
- ☐ Check Z-axis counterbalance cable
- ☐ Check electronic probes and cables
- ☐ Check measuring scales
- ☐ Check air system

Three Mo

- ☐ Check that the machine is level
- ☐ Check air system lines
- ☐ Check all machine functions
- ☐ Check electronic cabinet
- ☐ Check cable connections

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Machine Troubleshooting

Axes won't move

- Is the axis lock switch off?
- Is the air filter clogged?
- Is the air regulator set to correct pressure?
- Is the air regulator broken or leaking?
- Is the air inlet connected to air supply? Is the air supply on?
- Are any air lines broken? Broken air lines are indicated by excessive air escaping.
- Is the counterbalance regulator broken, leaking, locked, or is adjusted incorrectly?
- Is the counterbalance regulator set too low? Turn clockwise to increase.

Axes drag

- Is the axis lock switch off?
- Is the air filter clogged?
- Is the regulator set for the correct pressure.
- Is the counterbalance regulator adjusted correctly?
- Are any air lines broken? Broken air lines are indicated by excessive air escaping.
- Are the rails dirty?
- Are the axis loop cables too tight or positioned wrong?
- Is an air hose dragging on one of the rails?

Machine X or Y axes drift

- Is the machine level? Place a level on top of the X and Y rails.
- Check for axis loop cables interference.

Axes locks do not work

- Are any air lines broken? Broken air lines are indicated by excessive air escaping.
- Are the air lines properly connected?
- Are the pressures correct at the air regulator and counterbalance regulator?

Machine won't turn on

- Is the air pressure correct?
- Is the power cord plugged in?
- Is the voltage supply correct?
- Is power supplied to the receptacle?
- Check the fuse next to on/off switch on the controller cabinet.

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Machine Troubleshooting

Machine won't repeat measurement

- Are excessive vibrations occurring in the area of the machine?
- Is the part secure on the table?
- Is the probe tight in Probe Holder? Check that locking knob is tightened.
- Is the probe broken?
- Verify that the trigger force is correct for the stylus length. An incorrectly adjusted stylus is a source of non-repeatability.
- Shorter stylus lengths will give more repeatable results than longer stylus..
- Review your probing technique.
- Is the diameter of the stylus ball too small? Make sure the stem of the stylus does not hit against the part being measured.
- Is the temperature of the part, machine and the measuring environment stable and within specification?
- Is the TP2 (if supplied) screwed tightly into the probe body?
- Is the stylus screwed in tightly?
- Is the probe shanking on the part?
- Is the proper measurement plane selected (XY, YZ, ZX)?

Inaccurate measurements

- Is the part dirty or oily?
- Is the surface finish on the part poor? Using a larger diameter stylus ball will reduce the effect of surface finish of the part being inspected.
- Was the homing/initialization procedure followed correctly?
- Is an unqualified tip being used?
- Has the tip been moved after qualification?
- Has the qualification sphere been moved since the first tip was qualified? The reference offsets and tip 1 measurements must be repeated if sphere is moved.
- Has the probe been damaged?
- Check the temperature of the part, machine and the measuring environment. Are they stable and within specification?
- Are the DIP switches on the controller (if supplied) set correctly?

Probe does not take hits

- Are the cables correct and properly connected?
- Is the probe inhibit switch activated on the hand control? A "P", indicating that the TTP is enabled, should appear in the softkey area of the screen (MMII++ or MMIII).
- Is the probe interface (PI-6) loose or not present?
- Has the probe reseated? The red light on the probe should blink off and on each time a hit is registered. If the light remains off after a hit has been taken, gently move the stylus or the probe with your finger. The probe light should turn back on.
- Are the machine and computer cables correct and properly connected?

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Machine Troubleshooting

The MicroVal is running, but MicroMeasure is offline.

- A download failure has occurred (MMIII). At the DOS command prompt C:\mm3> type **c:\mm3\servo\dwnload** and press RETURN.

Movement is not smooth / Bearing is rubbing

- Stop using the machine immediately! Continued use could damage the guide-way system.
- Check to ensure that the air pressure for the machine is set to 55 psi.
- If the machine air pressure is set to 55 psi, consult Brown & Sharpe for help.

Oil appears from under the air bearings

- Clean the rails as described in "Cleaning the Bearing Surfaces"
- Check the machine's air filters and replace the cartridge if necessary.
- If oil appears frequently, the air supply may be particularly poor. It may be advisable to add a larger coalescing filter to the air supply upstream from the machine.

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MicroMeasure Troubleshooting

Message: Alignment Failed
Location: Alignment
Information: It was impossible to calculate the alignment. Probe the working plane and/or the elements again. Check working plane selection.

Message: Axis Error X, Y, Z
Location: Measurements
Information: An axis error indicates an axis or scale miscount has occurred. The indicated axis scale may need cleaning. If this error persists, contact Brown & Sharpe. In all cases DO NOT CONTINUE until this situation has been corrected.

Message: Calculating
Location: Anywhere
Information: Mathematical calculation being performed.

Message: Dir. Point (1 Hit required)
Location: Measurements
Information: The measurement sense required for probe tip correction is unknown or uncertain. Your data may be questionable. This direction point is an extra point to indicate from which direction the feature is being measured. In all cases, position the probe at the appropriate area and take a hit. The approach vector of your measurement points should be as perpendicular as possible to the working plane. For round objects, take hits towards the center of the radius. Do not take glancing hits. Reference "Probe Compensation" in the "Measurement/ Qualification" section of your *MicroMeasure User's Manual* for additional information.

Message: Divide by 0 Stack Dump
Location: Startup, after MicroMeasure logo screen
Information: Check the configuration of MicroMeasure. MicroMeasure looked for the VGA light pen and encountered problems. Check the correct screen type (EGA or VGA). Check the AUTOEXEC.BAT - was the light pen driver loaded? Is the light pen board seated in the expansion slot receptacle of the motherboard? Record the screen information and send it to your Brown & Sharpe representative. Restart the controller or computer and rehome the machine.

Message: Features Shifted
Location: Anywhere
Information: A warning that indicates the maximum number of 20 measurement names has been reached. The next measurement named, number 21, will shift out the first feature and so on.

Message: Foreground Overlap
Location: Anywhere in the program
Information: A system error occurred. Power the machine down and up and try again. If the error persists, contact Brown & Sharpe.

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MicroMeasure Troubleshooting

Message: Illegal Entry
Location: Anywhere
Information: Incorrect format followed for entry. Clean and try again.

Message: Last Block
Location: Learn Mode
Information: A warning in the "Learn" mode that indicates you are nearing the end of the "block storage buffer".

Message: Memory Allocation Error (Unable to Allocate)
Symptom: Some functions work, some do not.
Location: Anywhere
Information: Something other than MicroMeasure is running on your system (i.e. menu system, program manager, etc.). Brown & Sharpe will support computers and software *as they are shipped from Brown & Sharpe* without additional software. Problems arising from the use of other software packages are not the responsibility of Brown & Sharpe.

Message: No Solution for Element
Location: Measurements
Information: The best fit algorithm did not find a solution. Probe the element again. Improper data points or wrong working plane selected. A 3D element cannot be calculated from a 2D dataset. i.e. A sphere cannot be defined by measuring the equator of a circle. Try to cover the object with probing points.

Message: No Solution for Opt
Location: Measurements
Information: A mathematical solution for these elements could not be found. Improper data points or wrong working plane selected. Verify that you are taking the measurement properly.

Message: Not an Integer
Location: Keypad
Information: The program required an integer and you may have mistyped. Select C to clear and enter an integer number.

Message: No VolComp Table
Location: Measurements
Information: A table of compensation values cannot be found. For 1T machines contact Brown & Sharpe.

Message: Out of Range
Location: Keypad
Information: This entry is not allowed here. Clear and try again.

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MicroMeasure Troubleshooting

Message: Text Overflow
Location: Keypad
Information: There were too many keys pressed. The system will not accept any more. Re-enter correctly

Message: Tip Already Used
Location: Multi-tip Qualification
Information: You have selected to qualify a tip that was qualified earlier. Qualification of this new tip will overwrite the currently assigned tip number. If you want to overwrite, keep going. If you want to abort, press ESCAPE key.

Message: Tip Not Qualified
Location: Qualification
Information: Tip not previously qualified. Qualify tip and try again.

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PC Support Tips

Monitor picture is unstable (swimming) or flashes

- The monitor is too close to another electronic or magnetic device.
- Are the cables between the monitor and the rear panel of the system unit properly installed?
- Are the integrated VGA switches, or the switches and jumpers on the video adapter board correct?
- Is the display getting enough power?

Characters on screen out of focus

- Adjust the brightness control.

Printer doesn't work or prints very slowly/sporadically

- Is the printer cable plugged into the correct port?
- Is the printer out of paper?
- Is the printer jammed?
- Is the power cord plugged into the printer and electrical outlet?
- Are the printer settings correct?
- Is the printer ribbon working?
- Does the printer have the proper cable?
- Is the printer "on line" (selected by button on printer)?
- Reset printer by turning printer off, waiting for 10 seconds then turning the printer back on.
- Make sure the printer cable is completely secured to the computer printer port.

A serial or parallel device attached to a serial or parallel port on the rear panel of the system unit does not work properly.

- Is the attached device turned on?
- Is the cable properly installed between the device and the port?

Pressing the <Caps Lock>, <Num Lock>, or <Scroll Lock> keys does not light the corresponding lights on the keyboard.

- Is the keyboard cable installed properly?

The cursor appears on the monitor, but nothing happens when you press the keyboard keys.

- Is the cable between the keyboard and the connector on the rear panel properly installed?
- If the Num Lock, Caps Lock, and Scroll Lock lights are blinking, the keyboard password has been activated; enter the password to unlock the keyboard.

When MicroMeasure II++ or III is started, "OFFLINE" flashes in the lower part of the screen.

- The signal from one of the encoders is not reaching the processor. Make sure that the encoder cables are secured to the controller.

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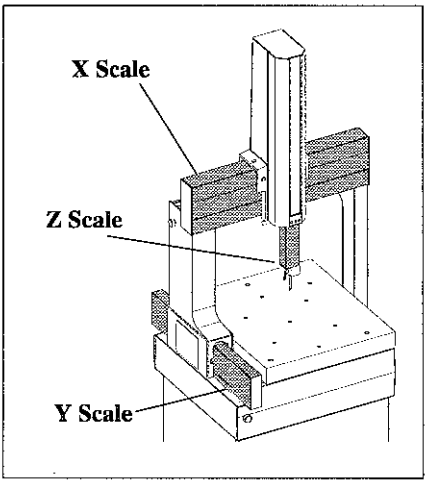
Cleaning Glass Scales

If it is necessary to clean the glass scales on the MicroVal 343, proceed as follows:



Cleaning the X Axis Scale

- Move the bridge to the rear of the machine.
- Move the ZX cariage to one end of its travel. Lock the machine's axes.
- Clean the measuring scale with a soft, anti-static cloth that is moderately wetted with pure alcohol. *Use only pure alcohol.* Allow the alcohol to dry.
  NOTE: Do not use any other type of cleaning fluid.
- Unlock the axes and move the bridge or carriage to the other end of its travel. Lock the machine axes. Clean the exposed part of the scale. It is important that all residue be removed from the scale.
- Check all surfaces for smudges and reclean as required.
- Unlock the axes and move the ZX carriage to the middle of the X-axis rail and lock the machine's axes.

Cleaning the Y Axis Scale

- Move the bridge to the rear of the machine. Lock the machine's axes.
- Clean the measuring scale with a soft, anti-static cloth that is moderately wetted with pure alcohol. *Use only pure alcohol.* Allow the alcohol to dry.
  NOTE: Do not use any other type of cleaning fluid.
- Unlock the axes and move the bridge to the other end of its travel. Lock the machine axes. Clean the exposed part of the scale. It is important that all residue be removed from the scale.
- Check all surfaces for smudges and reclean as required.

Cleaning the Z Axis Scale

- Move the bridge to the rear of the machine.
- Lower the Z-axis rail to its lowest point.
- Lock the machine axes.
- Clean the exposed end of the measuring scale with a soft, anti-static cloth that is moderately wetted with pure alcohol. *Use only pure alcohol.* Allow the alcohol to dry. It is important that all residue be removed from the scale. Check all surfaces for smudges and reclean as required.
  NOTE: Do not use any other type of cleaning fluid.
  NOTE: Because the end of the scale on the Z-axis is not normally exposed during operation, it is not anticipated that it will require periodic cleaning.

The procedure for cleaning the scales on the MicroVal 454 is similar to the MicroVal 343. On the Microval 454 the scales are fitted with covers that must be removed before the scales can be cleaned. Be sure the covers are cleaned and returned after cleaning the scales.

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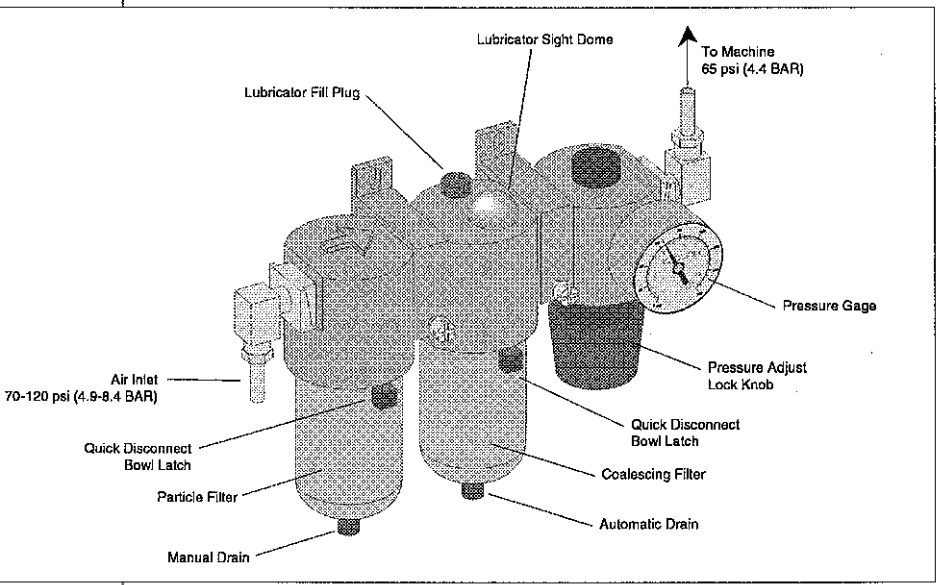
Changing the Air Filter

CAUTION

Be sure air pressure is shut off before attempting maintenance work on the air system. Make sure the bowl is properly in place and latched before turning on air pressure.

If it becomes necessary to replace an air filter or a filter element, obtain one from the factory. To replace the filter:

1. Turn off air to machine at supply. Make sure air pressure has gone to zero.
2. Using the release latch, remove steel bowl guard shield from filter.
3. Remove plastic filter bowl.
4. Unscrew filter element.
5. Assemble the new filter element and replace bowl and shield.



- The coalescing filter element may be washed in safety solvent and then dried and reused once or twice and then replaced. Air filters should be washed or replaced at intervals of 6 months if the air line is dirty.
- The coalescing filter has an O-ring on its upper surface. Be sure the O-ring is seated properly in the groove before reinstalling.
- If the filter gets dirty fairly quickly, place another air filter/regulator upstream of the machine.
- If excessive water is present within the air system at your facility use a Refrigerated Air Dryer (B&S # 80-462-113)

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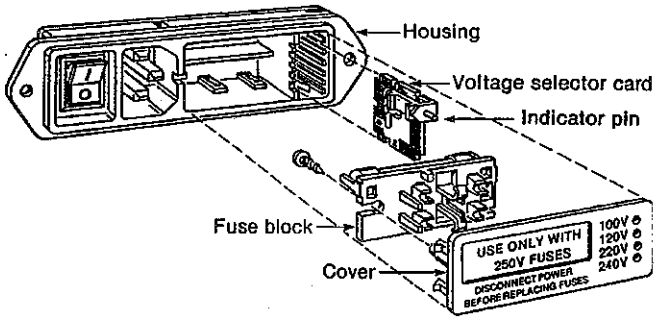
Power Module: Voltage Selection



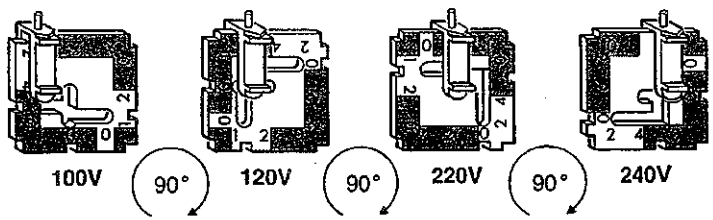
Power entry module has switchable voltage input selection.
The required fuse is shown below:

100 & 120 VAC: Use one 3 Amp slow blow fuse. 0.25 x 1.25 (B&S #80-404-104)
220 & 240 VAC: Use two 3.15 Amp slow blow fuse. 5 x 20mm (B&S #80-404-112)

Local electrical codes may determine exceptions to the fuse selection shown above. One or two fuses may be required depending on power line grounding.

To Change Selected Voltage:

- Open cover, using small blade screwdriver or similar tool; set aside cover/fuse block assembly.
- Pull voltage selector card straight out of housing, using indicator pin.
- Orient selector card so that desired voltage is readable at the bottom.
- Orient indicator pin to point up when desired voltage is readable at bottom (note that when indicator pin is fixed, successive voltages are selected by rotating the card 90° clockwise).
- Insert voltage selector card into housing, printed side of card facing toward IEC connector, and edge containing the desired voltage first.
- Replace cover, and verify that indicator pin shows the desired voltage.



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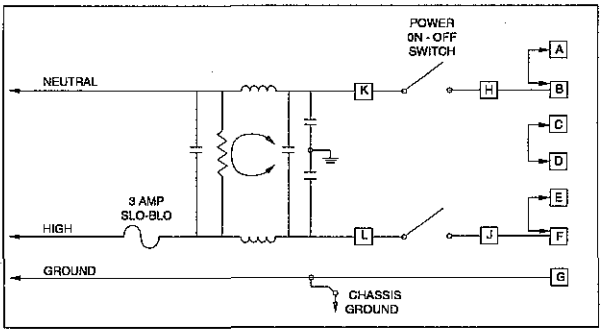
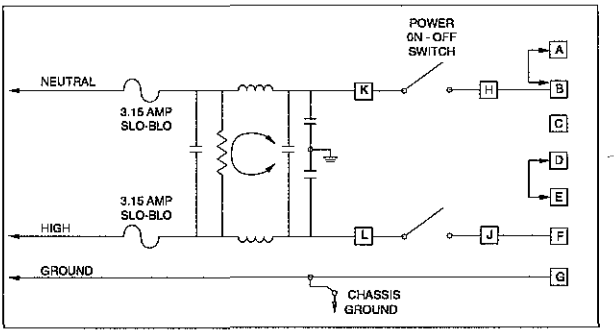
Power Module: Voltage Selection

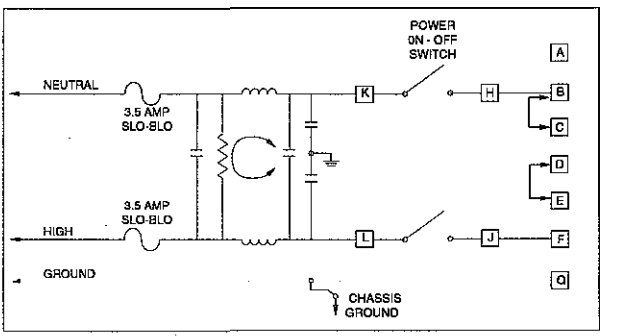
100 VOLT SELECTION INDICATED BELOW



200 VOLT SELECTION INDICATED BELOW



240 VOLT SELECTION INDICATED BELOW



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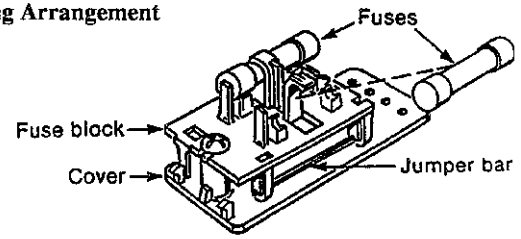
Power Module: Changing Fuses

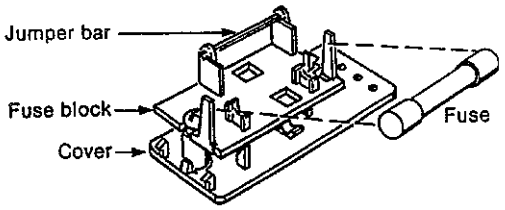
To Change from North American to European Fusing:

- Open cover, using small blade screwdriver or similar tool.
- Loosen Phillips screw 2 turns.
- Remove fuse block by sliding up, then away from Phillips screw and lifting up from pedestal.
- Change fuses (note that two European fuses are required, although a dummy fuse may be used in the neutral (lower) holder).
- Invert fuse block and slide back onto Phillips screw and pedestal.
- Tighten Phillips screw, and replace cover (note that fuse(s) that go into the housing first are the active set).

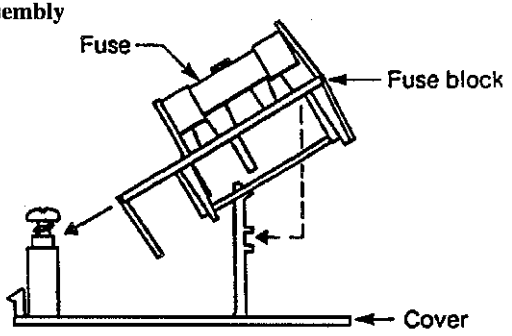
European Fusing Arrangement



North American Fusing Arrangement



Fuse Block/Cover Assembly



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Notes

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CHAPTER 5

Glossary

Glossary

Abort — To stop (cancel) an impending action or command.

Absolute Move — In DCC, the direct movement of the probe from one position to another by specified coordinates.

Absolute Touch — In DCC, the movement of the probe by coordinates from a position to a specified point on the part.

Absolute Value — A value which disregards the plus or minus signs of numbers and adds their values together.

Acceleration — The rate of change of velocity.

Accuracy — The deviation of a part or a measuring system from a known standard. The quantitative measure of the degree of comformance to recognized standards of measurement.

Active Plane — The plane in which you are currently working.

Actual Probe Diameter — The true size of the probe diameter.

Actual Value — The measured value of a feature.

Air Bearings — An accurate form of support for the moving axis elements of the machine. Air is forced by pressure through the space between the bearing pad and the axis way surface creating a film of air which permits movement of the machine's members with almost no friction.

Alignment — The procedure of relating the XYZ coordinates of a part to the coordinates of the machine, compensating for the fact that the part is not perfectly square to the machine's table. It shows the CMM where the workpiece lies.

Altitude — In DCC, the distance from the probe tip down to an inside or outside diameter.

Angle — The degree of difference between two features eventually meeting in a point.

Angle of Lines — A measurement routine that computes an angular distance between 2 line elements.

Angle of Planes — A measurement routine which computes an angular distance between 2 plane elements.

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Angularity	The measured angle between two features.
A.N.S.I. Y14.5	An American National Standards Institute standard for dimensioning of drawings.
Append	To add to an existing part program.
Applications Software	Software that provides the computer with instructions for a specific task, such as inspecting a part.
Approach Vector	The vector that the measurement software takes to calculate a pre-measurement position and approach the surface point on the part.
Array	An allocation of memory to be used in a program.
Automatic Probe Changer	A rack holding different probe tips and extensions. The machine can be programmed to pick up probes and extensions from the rack to use in measuring a part.
Axial Length Accuracy	The deviation from the known length of a standard placed parallel to the axis measured. Includes probe error.
Axis	A reference line from which distances or angles are measured in a coordinate system.
Axis Direction	The direction of any line parallel to the motion direction of a linear moving component.
Axis Feature	The centerline of a cone, cylinder or step cylinder.
B89.1.12	The American Standard (ANSI/ASME) for determining Coordinate Measuring Machine accuracy and performance.
Backoff Distance	The distance the probe backs off the part after a touch.
Backup Copy	A duplicate of a part program.
Ball Bar	A three-dimensional gage consisting of two precision balls of the same diameter, separated by a bar and used for determining volumetric accuracy. The bar must be sufficiently rigid that its length is constant during a set of measurements.
Ball Bar (Socketed)	A ball bar held by a socket which allows repeatable relocation at one or both ends.

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Ball Probe	A type of rigid probe used for measuring curves, lines and holes.
Bandwidth	The total bidirectional deviation from a nominal value (Maximum-Minimum range).
Best-Fit Feature	A feature constructed through the measurement points that most approximate a perfect feature.
Bilateral Tolerancing	A tolerancing method where the feature dimension is allowed to vary in both the positive and negative directions from the nominal.
Bolt Circle	A measurement routine which constructs a circle through previously measured circle center points.
Booting a System	The process of activating or loading the software into the computer. Powering the computer system so that the operating software becomes functional.
Boss	A circular raised projection on the surface of the work piece.
Bridge	The bridge is an inverted "U" shaped member that moves in the Y direction and supports the X and Z moving members.
Buffer	A storage (holding) area in a computer for measurement data.
CAD/CAM	Computer-Aided Design, Computer-Aided Manufacture.
Calibrate	To adjust a measuring instrument or inspect it for accuracy.
Calibration Sphere	An accessory used in qualifying the probe. A master sphere.
Cartesian	Feature output expressed as X, Y, and Z.
Cartesian Coordinates	A system used to describe points in space in terms of X, Y, and Z axes. The axes are perpendicular to each other. The points are expressed in relation to some fixed origin (zero point).
Cartesian Coordinate Measuring System	A measuring system that uses three independent, mutually perpendicular, axes to form a grid. The coordinates of a point are measured as distances from each of these axes.

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Centroid — The weighted center of all points that make up an element.

Character — Any letter, number, or punctuation mark that can be typed from a keyboard or displayed on a screen.

Circle — A geometric element defined by a minimum of three points equidistant from a centerpoint. A measurement routine used to compute the diameter and location of a bored hole or a cylinder.

Circle-Circle Distance — A measurement routine which computes the shortest two-dimensional distance (working plane) between 2 circle center points.

Circularity — The condition of a circle as it lies in a tolerance zone formed by two concentric circles. Also called roundness.

Clearance — In DCC, a system computation that determines if the probe has proper clearance to enter a hole based on information provided in the part program.

CMM — Coordinate Measuring Machine. A machine that performs physical movements necessary to inspect a part in three dimensions.

CMS — Coordinate Mesuring System. A system for part inspection that includes a coordinate measuring machine, controller, system computer and software.

Computer Assist — The use of a computer to process raw data into meaningful measurements. Probe movements are directed manually by the operator.

Concentricity — The location of a feature's axis in relation to another axis. A measurement routine that computes the TIR (Total Indicator Reading) between two circle centers.

Cone — A three dimensional space formed by a base and angled sides running from the base to the tip or apex. A minimum of six points are required to define a cone.

Contact Probes — Probes which must touch the part in order to make a measurement. They can be either rigid or electronic.

Contact Velocity — The speed of the probe as it actually takes a measurement and touches the part.

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Glossary

Coordinate	The X, Y, and Z values that identify the location of a point in space.
Coordinate System	A method of locating a point in space by assigning it a value according to its distance from a reference. Two types are Cartesian coordinates and polar coordinates.
Cosine Error	The measurement error in the motion direction caused by angular misalignment between the measuring system and the part being measured.
CPU	Central Processing Unit. The 'brain' of the computer.
CRT	Cathode Ray Tube. Another name for the computer screen or video display.
Cursor	An underline mark, arrow or rectangle that appears on the computer screen and marks the position of the next character to be entered.
Cylinder	A circular three dimensional space. A minimum of five points are required to define a cylinder.
Cylindrical Coordinates	Expressing a point in space by its (r, phi, z) in relation to some fixed origin. The same as Polar Coordinates.
Cylindricity	When all points of a cylinder surface are an equal distance from a common axis.
Data	Information that a computer understands and stores.
Database	An area of computer storage that holds the part programs.
Data Fit	Coordinate points in space that are put together by a computer to form geometric features such as planes, circles, lines, spheres, etc.
Datum	An origin or starting point for measurement, usually a major feature or surface. A reference point, line or plane to which the location or geometric characteristic of a feature is related.
Datum Feature	An actual, physical part feature on which a reference point is established.

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Datum Reference Frame — The perpendicular intersection of the primary, secondary and tertiary datum planes

DCC — Direct Computer Control. A type of coordinate measuring machine that uses motors to move the axes under computer control. DCC machines can automatically position a probe and record measurements without operator assistance.

Default — The preset value that a computer will assign to a variable if the operator does not enter a value.

Deviation — The difference between the actual measured dimension and the nominal dimension. Deviation is positive if the actual dimension is larger than the nominal. Deviation is negative if the actual dimension is smaller than the nominal.

Device — An auxiliary storage unit, such as a disk drive.

Diameter of a Rotary Axis — The maximum diameter of a rotary table supplied with a measuring machine. This is the maximum diamter on which a part can be fixtured.

Direction Cosine — One of three trignometric directional values (I, J and K) used to identify a feature's orientation in space.

Directory — A storage area for programs located in the database.

Disk — A storage device used to store part programs and other data collected by the computer.

Disk Drive — A device used to read and write information from the computer to a disk.

Distance — The shortest length between features.

Done — A function that signifies completion of the current display by the user.

Drift Test (Thermal) — A type of test for measuring temperature variation error on a machine.

Driven Manual Mode — A mode of CMM operation where the machine probe is moved from point to point by drive mechanisms that are manually controlled.

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Drive Point — In DCC, the point from which the probe moves to prepare for a measurement. Drive points are used so the probe does not touch the part while moving between measuring points.

Drive Speed — The speed of the probe between measurement points.

Edge Finding Probe — A rigid probe with a flat side for measuring the edges of parts.

Edit — A mode in which the user or programmer may make changes to an existing part program or routine.

Effective Probe Diameter — The actual probe diameter minus the response time of the touch trigger probe.

Element — A feature on the part that requires machine input. There may be more than one element for a feature.

Envelope — The measuring range of the CMM

Error Mapping — Computer correction of local errors with the measuring envelope of a Coordinate Measuring Machine. It requires a stiff, stable mechanical structure.

E-Stop — Emergency stop. A button that will immediately stop all systems.

Execute — The process of executing previously learned moves and measurements on the CMM. To run a part program.

Feature — A feature is the same as a measurement or alignment routine name. A feature contains elements which in turn contain CMM hits (measurements). An actual portion of a part such as a hole, slot or surface.

Feature Name — A user defined name assigned to a measurement routine's measured values.

Feature Substitute — In a multi-element routine, it gives the user the ability to substitute a previously saved feature routine.

Feature Type — Denotes the menu level feature name, such as Circle, Point, etc.

File — An organized collection of information stored in the computer as a unit.

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Glossary

File Name	A name used to store a file in the computer.
Firmware	Specific program functions stored on PROMs rather than in software.
First-Named Axis	The first letter in the name of the working plane. For example, in the XY working plane the first-named axis is X.
Flatness	A measurement routine that computes the deviation from true flatness of a plane.
Floppy Disk	A flexible disk for storing data collected by the computer.
Form	The amount a feature deviates from perfect. If form equals zero, the feature is perfect.
Form Tolerance	A type of geometric tolerance that controls the shape of a feature. Form tolerances include flatness, roundness, straightness, etc.
Free Floating Manual Mode	A mode of CMM operation where the probe is moved manually from point to point without use of a motor drive. Used only on machines with nearly frictionless bearings.
Gage	A mechanical artifact used either for checking a part or for checking the accuracy of a machine. A measuring device with a proportional range and some form of indicator, either analog or digital.
Geometric Dimensioning	The use of geometric shapes to define part features.
Geometric Elements	Seven shapes used to define a part and its features. The shapes are point, line, plane, circle, cylinder, cone, and sphere.
Granite	A dense, wear resistant, mineral used in the construction of CMM work tables. It is capable of being finished to excellent flatness.
Hard Disk	A rigid disk used for storing programs and data collected by the computer. It is usually permanently installed inside the computer.

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Glossary

Hard Probes — Solid probes. Mechanical probes terminating in balls, cylinders or taper shapes, or as rotating edgefinders. Can only be used with manual machines.

Hardware — The physical components of a computer system, including the CPU, keyboard, disk drive, monitor and printer.

Hit — A CMM input point of the current X, Y, Z coordinates originated by the user through a switch or touch trigger probe signal. A measurement.

Home — Machine zero. The 0, 0, 0 point (intersection) of the three machine axes X, Y and Z.

Host Computer — The computer that controls the CMM.

Hysteresis — A component of bi-directional repeatability caused by mechanisms such as drive train clearance, guideway clearance, mechanical deformations, friction and loose joints. The three types of hysteresis are setup, machine and probe.

IJK — A three-dimensional line that defines the direction of a vector. The directional components (cosine) of a vector in XYZ space.

Included Angle — An angle of less than 180° that is located between vectors.

Input — The information entered into a computer system.

Inspect — To manually check a part, not using the DCC mode of the machine. A mode where the operator uses all measurement capabilities yet does not save the steps to a part file.

Intersection — The creation of new geometric elements when two existing geometric elements cross each other.

Joystick — A lever on the joystick box used to control the movement of the axes of the CMM.

Joystick Box — A remote box used to manually move the axes on a DCC machine.

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Keyboard	A part of the workstation resembling a typewriter used for communicating with the computer.
Laser	Laser interferometers are used to determine scale accuracy of Coordinate Machines as well as to check geometry. They are considered an absolute length standards, since they use the unchanging wavelength of light.
Learn	To manually inspect a part with all moves and measurements being saved for future use under a specifically named program.
Least Square Method	The interpolation of a function to all points in a given data set.
Level	A part feature specified as a reference that is used during an alignment.
Length	A measurement routine that determines a measured perpendicular distance between a point and a line.
Lift	The thickness of the air film in an air bearing.
Light Pen	A pen used to input data into a program on machines with a touch screen.
Limit Tolerancing	A method of tolerancing that specifies the maximum and minimum size of a feature.
Line	A geometric element that consists of two points and has direction from one point to the other point.
Linear Coordinates	A method of locating a point by its distance from zero point along any of the three axes (X,Y,Z). Also called Cartesian Coordinates.
Linear Accuracy	A non-specific term sometimes used in reference to positional accuracy or to axial length accuracy.
Linear Displacement Acuracy	The difference between the true displacement of the probe along a straight line and that indicated by the machine measuring system.
List	To display a part program on the CRT.

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LLF	The learned list file or the part program.
Lobing	A systematic error in the measuring accuracy of probing systems such that a measured value depends on the displacement direction of the probe tip.
Login	The procedure performed to boot a computer. It usually involves typing a password.
Machine Axes	The X, Y, and Z axes built into the CMM. Each type of machine (vertical, horizontal, etc.) has different axes arrangements.
Machine Coordinates	X, Y, and Z values that have not been altered by part alignment compensation.
Machine Hysteresis	The hysteresis of the machine system when subjected to loads.
Machine Named Axes	The two axes of the machine's working plane. In the XY working plane, X is the first-named axis and Y is the second-named axis. The Unnamed Axis is the axis not named in the working plane, in this case Z.
Machine Setup	The routine operations performed on a CMM, such as calibrating probes and selecting measurement units.
Major Radius	The greatest possible distance between the outermost edge of an ellipse and its center.
Manual CMM	A Coordinate machine without motor drives on the axes.
Manual Control	The user controls the movements of the X, Y, and Z axes as well as the setup parameters.
Master Sphere	Same as Calibration Sphere. An accessory used in qualifying the probe.
Maximum Traverse Speed	The maximum speed along any given machine axis.
Mean Ambient Temperature	The mean temperature of the ambient environment surrounding a machine. It should be computed from at least two readings taken at the center of the machine's work zone during the interval of the test.

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Mean Gage Temperature	The mean temperature of a gage used for machine testing. It should be computed from at least two readings taken on the gage during the interval of the test.
Mean Scale Temperature	The mean temperature of a machine scale computed from at least two temperature readings taken on the scale during the test interval.
Mean Temperature	The average temperature computed from a number of temperature measurements at a specified location at equally spaced time intervals.
Measure	A mode where the operator uses the measurement capabilities and creates a part program saving all the steps into a learn list file.
Measurement	Machine inputs taken on the surface of the work piece where the location, diameter, etc. are computed.
Measurement Line	A line in the machine's work zone along which measurements are taken.
Measurement Point	A point in the machine's work zone at which machine coordinates are recorded as part of a measurement.
Measurement Software	The instruction program that tells the computer how to calculate the measurement data.
Memory	A part of the computer that stores information and program instructions.
Menu	A list of items displayed on the computer screen for selection.
Microprocessor	A device that performs the function of a computer except that the intelligence is built into the hardware and is not accessable for change by the user.
Menu	A screen showing choices of the activities the software can perform.
Midplane	A plane located between two points or lines and perpendicular to an imaginary line connecting them.
Midpoint	A point located at the center of a line segment. An alignment routine that locates the origin for the part's coordinate system midway between two elements and where the Minor axis is perpendicular to the Major axis.

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Minor Radius — The smallest possible distance between the outermost edge of an ellipse and its center.

Minus Tolerance — The negative amount that an actual measurement can deviate from its nominal value.

MMC — Maximum Material Condition. The condition of a feature in which that feature contains the maximum amount of material that is allowed by the toleranced dimensions (i.e. the smallest hole or the largest shaft).

Moire Fringe — An optical principle used on most Coordinate Measuring machines. It consists of a fixed glass or reflective steel scale and a moving reader head that counts (measures distance) as it passes along the scale.

Monitor — The video display on a computer. Also a screen.

Movable Component — A major structural component of the CMM which is movable relative to the machine base during measurement.

Multiplier — A value that effectively pushes the target point deeper into the part.

Named Axes — The two axes of the machine's working plane. Same as Machine Named Axes.

Nominal — The standard or desired dimension or size of a feature. The print values for the measurement as opposed to the measured values.

Nominal Coefficient of Thermal Expansion — An estimate of the coefficient of thermal expansion of a body. The effective coefficient of a scale and its mounting to the mcahine as measured in line with the scale.

Nominal Differential Expansion — The difference in thermal expansion between a machine's scales and a test part

Non-Contact Probes — Probes which do not touch the part being measured, using vision or laser scanning to measure the part.

Non-Seating Probes — A hard probe that requires force applied by the operator to maintain its position with respect to a measurement point.

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Normal — A surface, plane or axis that forms a 90 degree angle with a datum plane or axis.

Normal Vector — The vector that is normal to the surface of the part at a particular point. The negative of the Approach vector.

Numeric Variable — A value which contains only numbers.

Off-line — The condition in which a device, such as a printer, is not connected to or communicating with the computer

OIT — Operator Interface Terminal

On-line — A method of creating a part program on the CMM. This allows the programmer to create a program as the machine takes measurements.

Operating System — The software that controls the computer. It includes user commands, input and output routines, and normal computer operations.

Orientation (Part) — The alignment of an object with respect to a known reference.

Orientation (Probe) — The process of establishing the center of the probe tip with respect to an object, feature or other reference.

Origin — The zero point or center of the current coordinate system and alignment. It is a designated reference point for all measurements taken of the part.

Out-of-Tolerance — The condition in which a feature is larger or smaller than its specified dimension.

Output — Information displayed or printed by a computer.

Overdrive Distance — In DCC, the extra distance a probe travels to touch a point if the point is not at the specified position.

Parallelism — The condition in which all points on a surface or axis are equidistant from a datum plane or axis. A measurement routine where two features are parallel within a specified tolerance of size. One feature is the datum and the other is the toleranced line.

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Glossary

Part Alignment	The process of mathematically aligning the measurement axes of the CMM with the part axes.
Part Axes	The X, Y, and Z axes of a part.
Part Coordinates	X, Y, and Z values that have been modified by part alignment.
Part Orientation	The alignment of an object with respect to a known reference.
Part Program	A list of coded instructions that tells the system how to measure a part on a CMM.
Part Program Directory	A storage area that holds part programs.
Part Program Name	A label assigned to a part program. It is saved, retrieved and reused by means of this name.
Part Reference Frame	The axes alignment, datum position and working plane under which measurements are made.
Part Unnamed Axis	The axis not named in the part's working plane.
Passive Probe	A solid or hard probe which mechanically fixes the movable components relative to the workpiece.
Password	A word entered at the computer keyboard to gain access to programs or information stored in a computer.
Performance Test	Any of a number of test procedures used to measure machine performance.
Periodic Error	An error in the linear displacement accuracy of a machine that is periodic over an interval which normally coincides with a natural period of the machine scales.
Perpendicularity	The condition of a feature forming a 90 degree angle with another feature one of which is a datum feature. An alignment routine where the origin for the part's coordinate system is located at the intersection of the major and minor axes.
Perpendicular Intersect	An alignment routine where the origin for the part's coordinate system is located at the intersection of perpendicular lines formed by the major and minor axes.

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Glossary

Pitch Vertical deviation from a level plane, as applied to the travel of a CMM component along a given axis. The angular motion of a carriage, designed for linear motion, about an axis perpendicular to the motion direction and perpendicular to the yaw axis.

Pixel The smallest element into which an image is divided, such as the dots on a television screen.

Plane The surface of a part defined by at least three points. It is always straight in two directions.

Plus Tolerance The positive amount that a measurement can deviate from the nominal value.

Point A measurement routine consisting of one element (CMM input) which yields an X, Y, Z location. A point is the simplest geometric element.

Point Distance A measurement routine used to compute the straight line distance between two X, Y, Z locations.

Point of Origin The zero point or datum point.

Polar Feature output expressed as a radius and an angle.

Polar Angle In a polar coordinate system, the angle between the polar radius and the fixed reference line.

Polar Coordinates Points in space that are described in terms of radius and angle (r, phi, z) in relation to some fixed origin. Another type of coordinate system.

Polar Coordinate System A method of locating a point by its distance from zero along a measurement line and by the angle between the measurement line and a reference line.

Polar Radius The line that measures the distance from zero point to the located point in polar coordinates.

Positional Accuracy Deviation in readings between the CMM's display and those of a laser interferometer, usually taken at 1" intervals over the length of a single axis. It is not a measure of machine accuracy but indicates the linearity of the scales.

Position Velocity The speed of the probe between measurements.

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Post Hit Multiplier Same as multiplier. A value that pushes the target point deeper into the part.

Prehit Distance The distance of the probe from the part when it changes from position velocity to contact velocity. Also called the Probe Approach Distance.

Primary Datum The datum established with at least three points of contact between the most important functional surface and the inspection surface.

Probe On a CMM the component that touches and measures the part.

Probe Approach Distance The distance to the part at which the machine traverse speed is reduced to the probe approach rate for measurement.

Probe Approach Rate The nominal speed of the probe approach toward the part during measurement.

Probe Body The cylindrical part of a probe into which the stylus is mounted.

Probe Diameter The diameter of the probe tip whose value (radius) is used to compensate for measurements.

Probe Head The mounting portion of a probe that attaches to the Z Rail of the machine. The probe body is attached to the probe head.

Probe Hysteresis The hysteresis of the mechanical or electrical elements of a probe.

Probe Sense The inner or outer (+/-) consideration of the probe when measuring.

Probe Tip The part of the probe that actually makes contact with the part.

Profile A cross-section of a part, projected into some reference plane.

Program Listing A line-by-line list on the computer screen or on a printout showing the steps in a part program.

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Glossary

Projection	The reproduction of an existing feature on another existing feature.
Projection Plane	The plane to which a feature is moved during a projected measurement, usually the working plane.
Prompt	A question or statement on the video screen of a computer. A prompt asks for information or gives instructions.
Proportional Probe	A probe that gives a signal proportional to its displacement from the free position.
Prototype	A sample part that serves as a mode for production parts.
Qualification	A procedure for establishing true size, such as probe qualification against a known reference sphere.
Qualification Sphere	An accurate sphere with a known diameter, mounted on a post that can be fastened to the machine's table. Used to qualify the machine and the probes to be used.
Qualify	To inform the computer of the location and size of the probe.
Ram	The moving component of a machine that carries the probe.
Range	The difference between the maximum and minimum values of a set of measurements.
Readout	The display of X, Y, and Z coordinates.
Recall	To retrieve information that is stored in a computer.
Rectangular Coordinates	Expressing a point in space by its (X,Y,Z) position in relation to a fixed origin. A Cartesian coordinate measuring system.
Reference Sphere	Same as Qualification Sphere.
Repeatability	Deviation among multiple measurements of a feature or part. A measure of the ability of an instrument to produce the same measured value when sequentially sensing the same quantity under similar mesurement conditions.

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Glossary

Repeatable Socket — A socket that allows the accurate repositioning of one end of a ball bar.

Resolution — The least increment of a measuring device. On a CMM, the least reading on the display.

Response Time — The distance traveled by the probe from the time of actual contact with the part until the computer registers that contact.

Retract — The distance the probe backs up after contacting the part.

RFS — Regardless of Feature Size. A method of tolerancing that does not allow increased tolerance as the feature size varies. The tolerance must be met regardless of the size of the feature.

Right Hand Rule — A rule based on the right hand that defines the major, minor and third axis of a coordinate system.

Roll — The twist of an axis about a centerline. It is most obvious in the Z axis when using an extended horizontal probe. The angular motion of a carriage, designed for linear motion, about the linear motion axis.

Rotate — An alignment function used to rotate the part's coordinate system about the origin the specified amount of degrees.

Roundness — The condition of a circle as it exists within a tolerance zone formed by two concentric circles. Also known as circularity. A measurement routine which computes the deviation of a circle from true roundness.

Run — To execute a part program.

Runout — The deviation of a feature form from nominal during rotation of the part on the datum axis.

Safe Operating Temperature Range — The temperature reange in which a CMM may be expected to operate without physical damage to the machine or its support systems.

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Scale	The fixed portion of a measuring device.
Scaler	A modifier to a feature that defines a specific characteristic.
Screen	The video display on a computer.
Seating Probe	A hard probe that will maintain its location with respect to a measurement point without operator contact.
Secondary Datum	The datum established by at least two points of contact between a datum feature and the inspection surface.
Second Named Axis	The second letter in the name of the working plane.
Select	To choose from a list displayed on the computer screen.
Separate Origin	An alignment routine that requires three features and locates the origin at the third feature. The minor axis is perpendicular to the major axis.
Servo	The device that interacts between the computer and the CMM to control motion.
Settling Time	The time required between contact of a hard probe with a measurement point and the time at which valid data may be taken.
Setup	A softkey function used to access the setup screen.
Setup Hysteresis	The hysteresis of various elements in a test setup, normally due to loose mechanical connections.
Setup Parameters	Values such as position velocity, contact velocity, acceleration, retract distance, and prehit distance that are programmed into the system.
Significant Mean Temperature Change	The change in mean ambient temperature surrounding a CMM that, in the manufacturer's judgment, will cause sufficient degradation in machine performance to require the performance evaluation to be repeated.
Single Tip	A qualification procedure for a single tipped probe.
Slot	A measurement routine that computes a slot length and center distance from the origin.

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Software	The intelligence of a system. Stored in chips or on diskettes, it contains the mathematical and geometric capability to perform inspection routines and to communicate with the operator.
Sphere	A three dimensional space in which all points on its surface are equidistant from the centerpoint. A measurement routine that computes a diameter and the center distance from the origin of a spherical shape. A sphere is defined by at least four points.
Spherical Coordinates	Expressing a point in space by its (r, phi, rho) in relation to some fixed origin.
Spline	The interpolation of a series of functions between two given data points, for all the points in the set.
Squareness	Deviation of the axes from 90° in their relationship to each other.
Staging	The moving of a gage from first position to second position.
Static	Motionless.
Statistical Analysis	The examination of numerical information.
Step Gage	A gage consisting of a rigid bar with calibrated steps used for determining the accuracy of distance measurements in a direction of linear motion.
Straightness	A measurement routine that computes the deviation of a line from true straightness. Also, the deviation of an axis from a perfect path.
Store	To save information into a computer memory.
Stylus	The portion of a probe that contacts the part. Usually a synthetic ruby ball mounted on a steel shank.
Symmetry	The midpoint between two features. A symmetry feature is the mathematical bisector of two features.
Systematic Error	That portion of a machine error that results from computing the mean of a very large number of similar measurements.

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Taper Probe — A type of rigid probe used primarily for hole location.

Target — In DCC, a specified point on the part that is being measured.

Target Tolerance Zone — A zone around each specified target that allows for minor errors in the position of the target.

Temperature Variation Error — An estimate of the maximum possible measurement error induced solely by deviation of the environment from average thermal conditions.

Tertiary Datum — The datum established by at least one point of contact between a datum feature and the inspection surface.

Tolerance — Limiting values added to nominal dimensions that allow variations of a measured feature.

Tolerance Value — An acceptable deviation from a specified dimension.

Touch Point — In DCC, a point on the part, specified by coordinates, where the system records a touch.

Touch Screen — A senitive video screen that allows inputs to be made to a measuring program by means of a light pen.

Touch Speed — In DCC, the speed at which the probe is moving when it contacts the part during a measurement.

Touch Trigger Probe (TTP) — A precise switching device (contact probe) that holds a stylus. The stylus deflects slightly upon contact with a surface causing a mechanical change in the probe that is converted into a change of electrical voltage. Since the system knows its location at that moment, the X,Y,Z position of the probe is known.

Transformation — Conversion of machine coordinates into part coordinates.

Translate — An alignment function used to move the part's origin by a specified amount in the X, Y, Z direction.

Translation — The deliberate shifting of a datum to a predetermined location through numerical input to the computer.

Travel — The measuring range of a CMM.

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Glossary

Traverse Speed	The speed of the tip of the ram of a CMM, measured with respect to the part mounting surface, when the machine is moved between nominal locations without measuring.
True Position	The exact location of a point line or plane with respect to a datum or other feature.
True Position MMC	Allows for an increase in positional tolerance as the size of the feature changes.
True Position RFS	Refers to the feature having a true position regardless of a change in the size of that feature.
Unexpected Probe Hit	In DCC, any touch that occurs on an unspecified target. Also referred to as 'unexpected touch'.
Unnamed Axis	The axis not named in the machine's active working plane. For example, in the XY working plane, Z is the unnamed axis.
U Value	The value of the polar radius in the polar coordinate system.
Variable	Any value that is subject to change or revision.
Vector	Referred to as I, J, K. It indicates the direction of a feature's centerline. In the case of a plane, the vector is orthogonal to the measured surface, pointing in the direction from which the plane was probed.
Vibration Amplitude	Peak-to-peak amplitude of a given frequency component.
Video Terminal	A CRT. Another name for the computer screen.
V Value	The value of the polar angle in the polar coordinate system.
Volumetric Accuracy	Deviation among measurements of a ball bar or length standard.
Working Plane	Any of the orthogonal planes or surfaces of the part/ machine in which the operator may take measurements. The active plane in which features are measured.

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Glossary

Workpiece The object to be measured.

Work Zone The measurement volume of a CMM.

Working Tolerance The maximum acceptable range in the measurements for any performance test. This applied to repeatability, linear displacement accuracy, volumetric performance, bi-directional length measurement capability and point-to-point probing performance measurement results.

X-Axis The axis of a CMM that goes from left to right as you stand in front of the machine. Positive direction is to the right. One of the reference lines or axes in a Cartesian coordinate system.

Y-Axis The axis of a CMM that goes from front to rear. Positive direction is to the rear. One of the reference lines or axes in a Cartesian coordinate system.

Yaw Side to side deviation from a straight line, as applied to the travel of a CMM component along an axis. The angular motion of a carriage designed for linear motion, about a specified axis perpendicular to the motion direction. In the case of a carriage with horizontal motion, the specified axis shall be vertical, unless otherwise specified.

Z-Axis The vertical axis of a CMM. Positive direction is up. One of the reference lines or axes in a Cartesian coordinate system.

Zero Point The point in a coordinate system where the X, Y, and Z axes intersect.

Z Rail The vertical moving component that holds the probe. Also called Z Ram.

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Ram Optical Probe - Installation

CAUTION

The optical probe is a delicate instrument and must be handled with care. When not in use it should be stored in its original foam lined box with the protective cap on the objective lens.

To install the optical video probe on the MicroVal refer to the mounting configuration and the connecting diagram and proceed as follows:

1. Lock the MicroVal Z-rail.
2. Mount the optical probe in the probe holder at the end of the Z-rail and tighten the clamping handle (2).

CAUTION

Never unlock the Z-rail until you are sure that the counterbalance pressure is set correctly or the rail is firmly held.

3. If necessary, set the counterbalance pressure by holding the probe and unlocking the Z-rail and then adjusting the counterbalance regulator (3).
4. To measure tall parts it may be necessary to invert the mounting bracket (4) as shown. The two #10-32 screws that mount the bracket to the probe body must be securely tightened.
5. Attach the cable support bracket (5) to the middle of the black cable tray behind the X-rail.
6. Tie the fiberoptic cable, the video cable, and the zoom control wire (motorized probes only) together using stay straps (6).
7. Secure the cables to the brackets (4 and 5) with stay straps. The cables must not interfere with the movements of the Z-rail or the ZX carriage.
8. Connect the components as shown in the connecting diagram. The fiberoptic illuminator must be located as far away as possible because of the heat generated by the illuminator.

Refer to the RAM Optics Instruction Manual for additional information.

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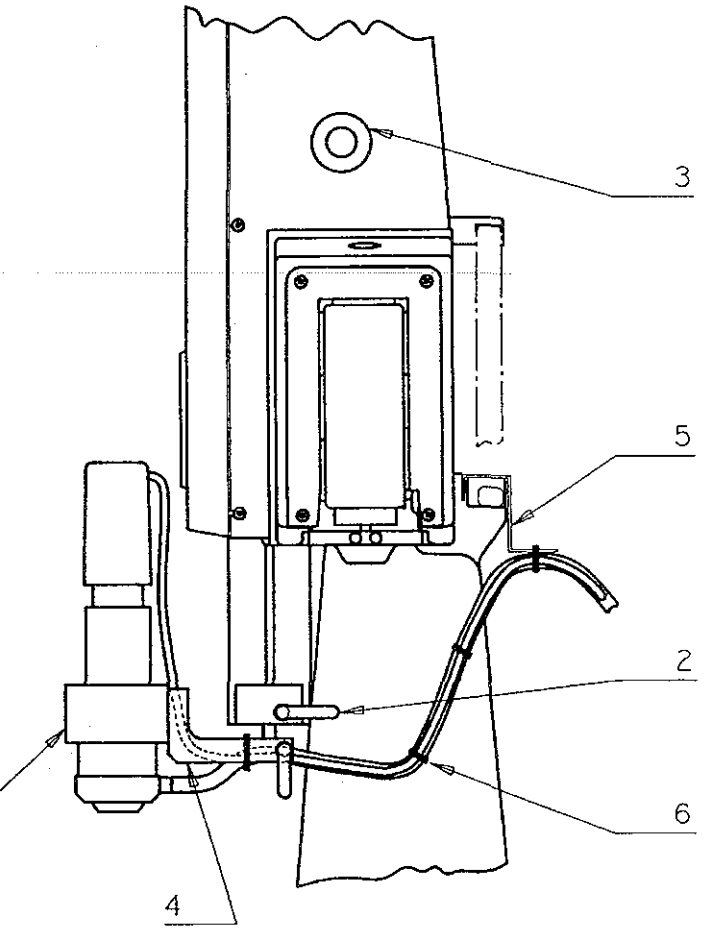
ɔnfiguration



TICAL PROBE 2. CLAMPING HANDLE 3. COUNTERBALANCE PRESSURE REGULATOR
UNTING BRACKET 5. CABLE SUPPORT BRACKET 6. STAY STRAP

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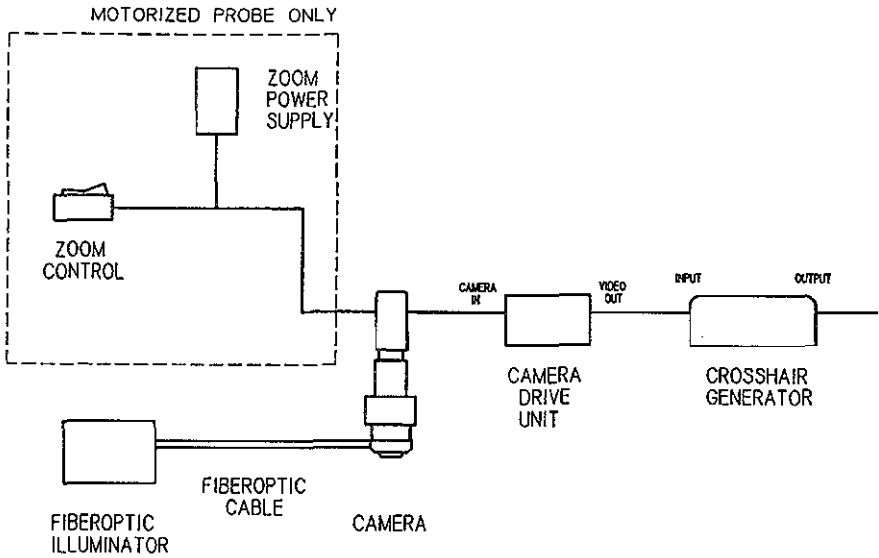
Ram Optical Probe - Installation

Connecting Diagram



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Ram Optical Probe - Adjustments

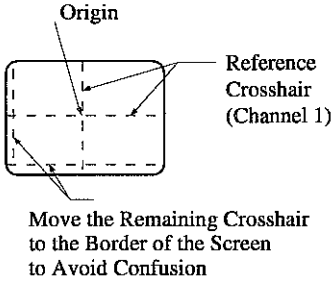
Probe Parfocality
If you plan to change the magnification (use zooming) while measuring, check to see that the probe remains in focus (parfocal) throughout the zooming range as follows:

1. Focus on a part or on the MicroVal's granite table using the probe's highest magnification.
2. Zoom to the lowest magnification while observing the image on the monitor screen. If the image goes out of focus, the parfocality of the probe should be adjusted.
3. Refer to the RAM Instruction Manual for the procedure on parfocality adjustment.

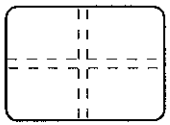
Crosshair generator
The crosshair generator provides two pairs of reference lines on the monitor screen (two vertical and two horizontal). The location can be electronically controlled. The lines can be made black or white, solid or dashed. The ideal placement of the reference crosshair is in the middle of the screen.

Note: Never change the location of the reference crosshair on the screen while performing measurements.

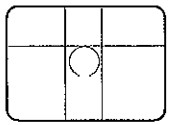
a. General Purpose



b. Can be Used for Referencing
Straight Edges and Lines



c. Convenient for Referencing
Small Features of the Same Size
Do Not Zoom During Measurements



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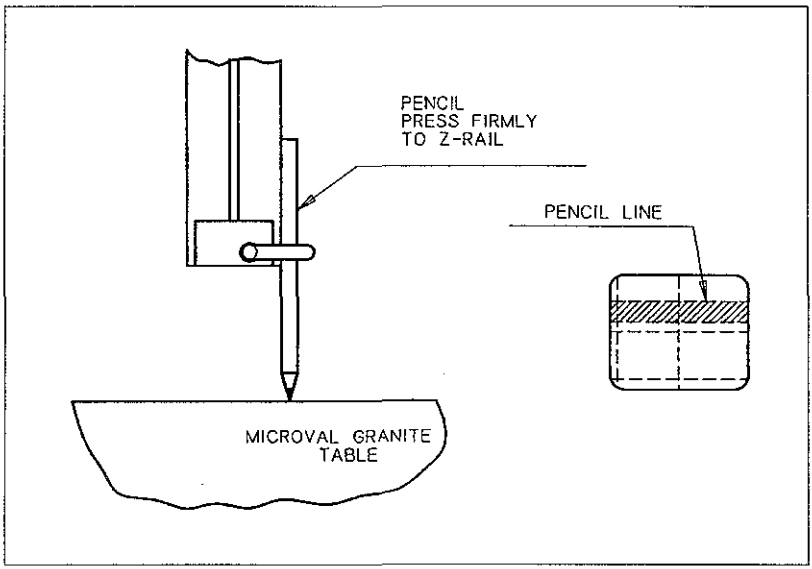
Ram Optical Probe - Adjustments

The possible configurations of the reference crosshairs are shown on the preceeding page. If you change magnification (use zooming) while measuring, be sure that the reference crosshair is coincident with the optical axis of the probe. Refer to the RAM Instruction Manual for the procedure on adjustment of the crosshair position.

Crosshair Alignment
It is recommended that the crosshairs on the monitor screen be aligned to the X-axis and Y-axis of the MicroVal. To align the crosshairs:

1. Lock the Y-axis.
2. Using a sharp pencil, draw a line on the surface of the granite by holding the pencil tight to the Z-rail and moving the ZX carriage along the X-axis.
3. Using the lowest magnification, focus the probe on the pencil mark on the granite table.
4. Holding the optical probe with one hand, release the clamp (2) and rotate the probe in the Z-rail until the crosshair is parallel to the image of the pencil line.
5. Tighten the clamp (2).



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Ram Optical Probe - Qualification

Probe Qualification
To qualify the optical probe:

1. Turn the MicroVal electronic cabinet "Off" and then "On".
2. Remove the probe from the Z-rail.
3. Clamp the MicroVal qualification sphere to the granite table in the right rear corner (or any location where it will not interfere with the part being measured).
4. Home the MicroVal and press "Done". Tell the system it has an optical probe.
5. Place the MicroVal Z-rail on the qualification sphere and press "Done".
6. Clamp the optical probe in the Z-rail.
7. Align the crosshairs on the monitor screen to the X-axis and the Y-axis of the MicroVal.
8. Focus the probe on the equatorial plane of the qualification sphere using the lowest magnification.
9. Take three measurement points equally spaced on the circumference (refer to the following section on measuring with the optical probe).
10. Focus the probe on the top point of the sphere and bring this point to the origin of the reference crosshair on the monitor screen.
11. Take a measurement point and press "Done".

Part Alignment
To perform a part alignment:

1. Select the appropriate alignment routine from the Main Menu.
2. Select the X-Y plane as your working plane.
3. Focus on the plane to be measured by moving the probe towards the part (as if measuring with a hard probe).
4. Focus on and measure at least three points on the working plane spaced as far apart as practical. Press "Done".
5. If a direction point is requested, elevate the probe and take it. This will insure the consistent orientation of the part coordinate system.
6. Define the major axis and the origin of the part coordinate system in accordance with the selected alignment routine.

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Ram Optical Probe - Measuring

The Fine Adjust Option (Brown & Sharpe #682-102-1) is required for the MicroVal for most measurement operations using the optical probe. The MicroVal 454 is equipped with a fine adjust mechanism.

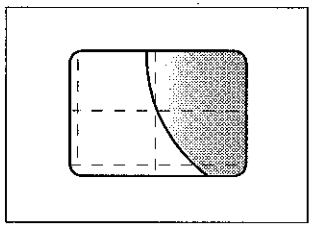
When positioning the probe, hold the end of the Z-rail and not just the body of the probe. Use the X anf Y fine adjusts for accurate positioning of the probe and use the Z fine adjust for focusing.

The optical probe has a variable magnification up to 125X (250X if an auxiliary lens is installed). To get the highest accuracy, zoom the probe to the highest magnification. Use the lower magnification to get a wider field of view and a larger depth of field.

It is helpful to consider the optical probe as a solid ball with a ball diameter of zero or as an edge probe. You must "tell" the Micromeasure software when to record the coordinates of the selected point on the part surface. This is done by pressing the appropriate button on the MicroVal hand control ("taking a hit").

The principles of referencing part features with the optical probe are similar to those for projectors and measuring microscopes:

1. Manually position the probe so that the edge to be measured is in sharp focus on the monitor screen.
2. Using the X and Y fine adjust mechanisms of the MicroVal, position the origin of the reference crosshair on the edge to be probed.
3. Record the coordinates of this point ("take a hit").
4. Take more measurements on this edge or go to another feature.



Note: The location of features is most easily done at the lowest magnification settings. To get the highest measuring accuracy, however, the highest magnification should be selected. When zooming during measurements, be sure that parfocality and crosshair position are properly adjusted.

The optical probe is used primarily to perform measurements in the X-Y plane. Heights of features in the Z-direction can also be measured. To do this:

1. Select the "Step" routine from the Distance Menu.
2. Focus the probe on the top plane of the feature, take two measurement points on this plane and press "Done".
3. Focus on the bottom plane of the feature, take a measurement and press "Done".

Use the highest practical magnification during this procedure for the best accuracy.

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Notes

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